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THE JOURNAL  
OF  
UROLOGY

VOLUME VII

173 606  
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1/9/22

BALTIMORE, MD.  
1922

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# CONTENTS

## NUMBER 1, JANUARY, 1922

An Operation for the Cure of Incontinence Associated with Epispadias. Hugh H. Young.....	1
Treatment of Malignant Disease of the Prostate and Bladder. J. T. Geraghty.	33
Calcification of the Seminal Vesicles. Herman L. Kretschmer.....	67
Modification of Differential Functional Test with Phenolsulphonphthalein. Anders Peterson.....	73
Malignant Disease of the Adrenals with Report of a Case. H. G. Fuller.....	77

## NUMBER 2, FEBRUARY, 1922

A Survey of the Treatment of Acute Gonorrhea in the Male. A. Reith Fraser.....	87
Gonococcal Infections of the Kidney. Report of a Case with Traumatic Rupture. R. R. Simmons.....	113
Chronic Infections of the Male Urethra and its Adnexa. H. Ernest Paul.....	125
The Operative Treatment and Pathology of Acute Epididymitis. John H. Cunningham and Ward H. Cook.....	139
Suction Drainage with Presentation of an Apparatus. Meredith F. Campbell.	153
Acknowledgment of Priority for the Treatment of Impacted Calculi in the Lower End of the Ureter Released by Fulguration. Hugh H. Young.....	161

## NUMBER 3, MARCH, 1922

Lympho-Cystic Urethral Lesions. An Evidence of Systemic Tuberculosis. P. S. Pelouze.....	165
Urethroscopic Findings in Functional Disorders of the Genito-Urinary Tract. Abr. L. Wolbarst.....	209
The Use of the High Frequency Current in the Treatment of Lesions of the Deep Urethra. H. McClure Young.....	221
Types of Nephritis which Lead to Uremia. Nellis B. Foster.....	235
Foreign Bodies in the Bladder. R. V. Day.....	243

## NUMBER 4, APRIL, 1922

Atrophic Pyelonephritis. William F. Braasch.....	247
Observations on the Physiology and Pathology of the Ureter. Wm. C. Quinby.	259
Concerning the Effect of Saline Purgatives on the Absorption and Excretion of Phenolsulphonphthalein. David I. Macht.....	271
Pneumopyelography. A Preliminary Report on Its Advantages and Tech- nique. Samuel A. Thompson.....	285

Dissolution of Calculi in the Renal Pelvis and Ureter. Robert C. Bryan and R. D. Caldwell.....	295
Surgical Infections of the Kidney. J. N. Baker.....	307
The Toxicity of Potassium Chloride in Experimental Nephritis. Frank P. Underhill and Roy C. Ferguson.....	311
Unilateral Fused Kidneys. A. Hyman.....	321
Saligenin as a Local Anesthetic for Cystoscopy in Men. Arthur D. Hirschfelder, A. G. Wethall and Gilbert J. Thomas.....	329
Presentation of Test-Tube Holder for Collection of Ureteral Specimens. Charles S. Levy.....	333
An Inexpensive Carrier and Receptacle for Ureteral Catheters. Emma C. Schroeder.....	335
Urological Irrigator Sterilizer. Arthur B. Cecil.....	337

## NUMBER 5, MAY, 1922

A New Method of Perineal Prostatectomy which Insures More Perfect Functional Results. A Preliminary Report. John T. Geraghty.....	339
Diverticula of the Bladder. Arthur H. Crosbie.....	353
Sphincterotomy per Urethram. A Simple and Safe Procedure for the Cure of Contracture of the Vesical Orifice. J. T. Geraghty.....	367
The Structural Basis for Congenital Valve Formation in the Posterior Urethra. Ernest M. Watson.....	371
Bone Metastasis from Primary Carcinoma of the Urinary Bladder. H. Gideon Wells.....	383
A Procedure for the Cure of Prostatic Abscess. B. S. Barringer.....	397
A Case of Prostatic Infection Complicated by Osteomyelitis. James Pedersen.....	405
Physiological and Pharmacological Studies of the Prostate Gland. IV. Response of Prostatic Muscle to Drugs. David I. Macht.....	407

## NUMBER 6, JUNE, 1922

Some Disputed Points Regarding Prostatectomy. Arthur L. Chute.....	417
Transactions of the New England Branch of the American Urological Association.....	431
Pneumoperitoneum in Kidney Diagnosis with Special Reference to the Detection of Retroperitoneal Masses. L. R. Sante.....	451
The Extension of Hypernephroma by Way of the Renal Vein. Linwood D. Keyser and Gordon S. Foulds.....	463
The Relation of the Colon Bacilli of Renal Infections to Strains from Other Sources and Observations on Hemolytic Colon Bacilli. Russell D. Herrold.....	473
Pyelitis of Pregnancy. W. G. Sexton.....	481
A New Sign in the Diagnosis of Ureteral Stones. Bransford Lewis.....	487
Human Bladder Muscle Under Increased Tension. John C. Baldwin.....	499
Scrotal Bandages. Clyde W. Collings.....	501

## AN OPERATION FOR THE CURE OF INCONTINENCE ASSOCIATED WITH EPISPADIAS

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In a previous article (16) the author published a new technique for the radical cure of epispadias. This operation was not intended for cases associated with incontinence. Since then three patients with epispadias associated with complete incontinence have appeared at this clinic and the author, having devised a method for the radical cure of the incontinence, begs leave herewith to report two of these in full.

The question is interesting because we have been unable to find in the literature any similar operation, or in fact, any operation in which a restoration of the vesical neck, the internal or external sphincters to cure incontinence was attempted. I have also been unable to find any male case in which by any procedure the incontinence of urine was radically cured. It has been acknowledged for many years that the external procedures directed to repair the defect of epispadias in the male are powerless to cure incontinence. We have not the space to discuss the developmental anomaly responsible for the various degrees of epispadias, but we may quote from a monograph by Dr. Berry Hart (1).

The cloacal membrane, as was first pointed out by Kölliker, and afterwards confirmed by others, has at one time no mesoblast, and is thus a part structurally weak. The upper boundary of this membrane is the navel, and its lower the junction of end-gut and entodermal cloaca. In the adult this lower point is on the perineal body in front of the anus, as in the rare malformation, viz., persistent end-gut in a female child; I found this part of the gut attached to skin in front of the anus. In the adult, therefore, the cloacal membrane is represented by the mesial region from navel back to perineal body—the anterior boundary of bladder, pubes, urethra and vestibule.

The best explanation of extroversion is afforded by the facts now known as to bladder development and the cloacal membrane. The bladder in the human female, is not developed from allantois except at its apex, but is derived along with the urinogenital sinus from the anterior division of the entodermal cloaca. This cloaca has the cloacal membrane as its anterior boundary and as this boundary has no mesoderm at one period, it may yield or cleave. This yielding, if complete, necessarily exposes all that is derived from the anterior gut division, viz., bladder, urinogenital sinus, lower third of vagina as in Champney's case. Less degrees of fissure in linear extent or depth give the other lesions. These are therefore explained, as Keibel has so well shown, by the actual development of the parts plus some bursting or dilating cause which, if it does occur (and of that we have as yet no proof) must do so at an early period of embryonic life.

The most important article on epispadias with incontinence by Stiles (8) concerns only the female, but as many of the problems are similar I shall quote from this paper at length:

It is unnecessary to give a detailed description of all these lesions. Suffice it to say that they consist in order of severity of: partial epispadias, where the deeper part of the dorsal wall of the urethra is developed; complete epispadias, where the dorsal wall is entirely absent; and subsymphyscal extroversion, where the sphincter at the neck of the bladder is deficient and there is more or less protrusion below the symphysis of the mucous membrane of the posterior wall of the bladder. It is often impossible to say whether one is dealing with a complete epispadias or a slight degree of subsymphyscal extroversion. From the practical point of view the two conditions may be classed together, as they both give rise to incontinence and call for the same treatment.

The indications for treatment are obviously twofold, namely, to rid the patient of the incontinence, and to repair the cleft condition. It is the incontinence and not the deformity which causes the patient to seek advice, and it is this condition which has so severely taxed the ingenuity of the surgeon. Time will not permit to describe in detail the various operative procedures which have previously been adopted. Moreover, the results of these procedures have proved so disappointing that I shall content myself with referring the reader to the admirable papers of Dr. J. W. Ballantyne (1895) (2) and Nové-Josserand and

Cotte (1907) (3). The former author, after describing a typical case in an unmarried woman aged twenty, who sought advice at his clinic at the Edinburgh Western Dispensary, gives a historical and chronological résumé of all the literature on the subject. He found records of thirty-three cases, and appends a full bibliography. Nové-Josserand and Cotte, after describing a case in a girl of five and one-half years of age, cover much the same ground as Dr. Ballantyne. They found records of thirty cases, and they give an admirable epitome of the operative technique of the eighteen cases which were subjected to surgical treatment. In none of these eighteen cases were the ureters transplanted. In all except one (in which Mr. Makins (4) closed the abnormal urethra and substituted for it a suprapubic fistula, with the object of making it easier for the patient to wear an artificial receptacle for the urine), a plastic operation was carried out on the vulva and urethra with the double object of repairing the cleft and at the same time dealing with the urethra in such a way as to endeavor to overcome the incontinence. The former object is not difficult to attain, but as might be anticipated the procedures directed towards curing the incontinence almost invariably failed. The various methods employed have consisted either simply in narrowing with lengthening. The narrowing was effected either by simple cauterization, by suturing the raw edges obtained by lateral incisions, by urethral colporrhaphy, or by a plastic operation combined with torsion. A combination of lengthening and narrowing of the urethra was attained in one of three ways: (1) by dissecting down a triangular flap from the mucocutaneous trough above the abnormal meatus so as to restore the superior wall of the urethra; (2) by the formation of two lateral flaps combined with supraurethral colporrhaphy; (3) by combining lengthening with torsion of the urethra. As might be anticipated, most of the operators found no difficulty in attaining a satisfactory cosmetic result by restoring the anterior commissure and uniting the two halves of the clitoris above the urethral orifice. In all but three cases, however, the incontinence persisted, and in those in which continence was said to have been obtained, it is difficult to gather how far the cure was complete and permanent. As Nové-Josserand remarks: "By lengthening the urethra, and restoring the meatus to its normal position, a certain amount of curving of the canal is probably produced, and this change of direction of the urethra, which has been both lengthened and narrowed, may be sufficient to bring about a temporary mechanical closure of the bladder. In all the cases reported, it is evident that the continence of the urine is obtained by

the purely mechanical means of damming back the urine, and that the sphincter is not in any way responsible for it. When the vesical pressure attains a certain degree, the obstacle which has been created to close the urinary reservoir is forced and the urine escapes." Quite recently, Goebell of Kiel (5) has introduced a new principle of treating epispadias in the female, namely, that of utilizing the pyramidal muscles to form a vesical sphincter. By dissecting upwards a flap by means of a transversely curved suprapubic incision, these muscles are freed laterally and at their apices. After separating the recti and freeing the neck of the bladder from the vagina, the pyramidales are turned downwards and stitched together in the space between the neck of the bladder and the anterior wall of the vagina. The muscles are also united above the neck of the bladder, and if they are sufficiently well developed they are made to cross one another before they surround the neck of the bladder. By this procedure, Goebell maintains that he converts the pyramidal muscles into a voluntary sphincter. The nerve supply, which is derived from the termination of the last intercostal nerve, enters the muscle laterally at its base and is not therefore interfered with. As the result of this operation the child's condition was so far improved that she occasionally slept the whole night through without wetting the bed, but she was unable to keep herself dry when playing or walking about. Still another method is that of Hackenbruch (6), who, after exposing and freeing the anterior surface of the bladder by a suprapubic incision, lengthens its neck by the application of several transverse reefing sutures. Goebell, however, claims his method is superior, from the fact that he provides the neck of the bladder with a sphincteric apparatus made up of a voluntary muscle.

Stiles further states:

Before operating on my own cases, I felt that if the incontinence were to be really cured there was no alternative but to transplant the ureters into the intestine, and this in spite of the fact that experiments on animals, as well as the reported cases in which this procedure had been carried out on the human subject, had given very unsatisfactory results, and had been attended with a high mortality. The fatal results following transplantation of the ureters into the intestine are due either to immediate or remote complications. Chief amongst the former is peritonitis, due either to peritoneal contamination at the time of operation or to subsequent leakage of urine or feces, to undue traction of the urethra, or to local sloughing. Of the remote complications the



most important is that which results from an ascending infection of the kidney (either apart from or associated with hydro- or pyonephrosis), the result of cicatrization and stricture at the seat of implantation. It is to be noted, however, in epispadias without extroversion of the bladder, that in order to transplant the ureters along with their orifices, the first step in the operation would entail gaining access to them either by opening the bladder suprapubically or by an extensive perineal dissection, either of which procedures would greatly complicate the operation as well as render it a formidable one. It seems to me therefore that the best course to adopt in epispadias without extroversion of the bladder is to expose and divide the ureters as close to the bladder as possible by the intraperitoneal route, and then to transplant them separately into the lower part of the pelvic colon. This brings us back to the vexed question as to how this can best be done so as to guard as far as possible against an ascending kidney infection. In 1892, Maydl, following Tuffier's suggestion, introduced a new principle into the operation; this consisted in transplanting, not the divided ureters, but an elliptical portion of the trigone of the bladder containing the ureteric orifices into the pelvic colon, the object being to retain the natural sphincteric fibers surrounding their orifices and so to prevent regurgitation of the intestinal contents and consequent infection of the kidneys. This method has the further advantage of preventing stricture and hydronephrosis. According to Zesas, 71 of the 97 cases operated on by Maydl's method recovered. Of the 26 fatal cases, 2 died of shock, 13 of pyelonephritis, 5 of peritonitis, 3 of infiltration of urine, 2 of kinking of the ureters. Ascending infection of the kidneys might be the cause of death up to two years after operation. The sphincteric control over the urine seemed to be satisfactory in most cases. Berg's method of forming a bladder out of an isolated portion of small intestine, Gersuny's plan of transplanting the ureters along with the trigone into the isolated rectum and then pulling the lower end of the pelvic colon through the pouch of Douglas and bringing it out at the perineum within the sphincter ani; and, lastly, Subbotin's method of making a communication between the ectopic bladder and the rectum and forming a reservoir for the urine out of the mucous membrane of the rectal canal, although ingenious and theoretically attractive, are too complicated as well as too formidable to be selected in preference to the more simple procedure. Steinke sums up the results obtained as follows: 'Of the 35 cases recorded above, 2 have no statement as to whether or not the patient lived after the operation. However, 15 are reported as

recovering, and 18 resulted fatally, making a general mortality of about 54.5 per cent. Two cases died of tuberculosis of other organs, thus making the mortality from the operation and its effects 55 per cent. Of the 15 cases reported as living, two are unilateral implantations, and unilateral cases are really no test, as there still remains one good kidney to carry on the function. This leaves 15 of the 27 bilateral cases recorded as living after four weeks or more, making a mortality of 55.5 per cent. These results show that under certain conditions the ureters may be transplanted successfully. The ultimate results are, however, uncertain, and fatality is apt to occur under the best circumstances."

An extensive article by Steiner (9) in 1873 gives in great detail the literature and a résumé of all the cases which had been reported up to that time. A careful review of this work shows no case in which the surgeon attempted to do more than perform a plastic operation upon the epispadias to close the defect. No attempt to restore the neck of the bladder or the sphincters, either external or internal, was carried out. In a few cases, the operator reported a slight improvement in the incontinence as a result of these partial procedures. Several patients were able to retain urine while in bed and two for an hour or two during the day, but no case in which restoration to normal urination followed the operation is recorded.

Page (10) reported a case of epispadias with partial incontinence operated on by Cantwell's method, in which complete control of urine resulted. The patient is reported to have been able to retain urine for 7 hours during the day and all night. This case, as noted, was not one of complete incontinence and is therefore, unlike those we have recorded.

Stettiner (11) discusses the cure of incontinence of urine associated with epispadias in females and refers again to a method of constructing the vesical orifice by means of three stitches placed in the wall of the urethra and then drawn together, narrowing the tube, but without excision. No excision and no attempt to restore the vesical neck was made. He also describes the use of the pyramidalis muscles according to the method of Goebell, above referred to. The results obtained, however, were said to be unsatisfactory.

Stoeckel (12) in 1920 reviews the procedures previously described and also comments on the use of a plastic through the vagina, in which an attempt was made to tighten the vesical neck by means of vaginal plastic, but again without satisfactory results.

Barney (13) states that he relies upon training the sphincters to combat the incontinence in these cases, after having closed the epispadiac defect by means of a plastic, in which the prepuce is used. No details of the results obtained in incontinence are given.

The author has been interested in the treatment of incontinence since his publication in 1908 (14) of a new procedure for the cure of incontinence of urine by suture of the urethrae and vesical sphincters in a case of incontinence following median perineal urethrotomy, in which both the external and internal sphincters had been injured. In this case the incontinence was complete and cystoscopy showed that both internal and external sphincters were widely dilated as the result of an incision made along the floor of the urethra into the bladder. The operation consisted of: first, suprapubic cystostomy; excision of mucous membrane along the posterior portion of the vesical orifice uncovering the muscle; closure or narrowing of the prostatic orifice by transverse sutures of catgut. Second, exposure of membranous urethra through perineum; excision of mucous membrane of the floor on each side; exposure of sphincter muscles; closure with several layers of catgut sutures. Third, suprapubic drainage. The result obtained in this case was perfect. The patient was restored to entirely normal urination, able to retain urine all night and several hours during the day.

Since then, several cases of incontinence of urine, mostly post-operative, either from perineal lithotomy, urethrotomy, or prostatectomy perineal or suprapubic, have been operated upon by this procedure with satisfactory results. The subject has been discussed at length by the author in a recent article (15). In this paper, a particularly difficult case of incontinence associated with rectourethral fistula, in which a complete cure was obtained, is recorded (see figs. 1 to 4). In these cases of

operative incontinence, however, the problem was to restore sphincteric control, generally both external and internal, by repairing the injury along the floor of the urethra, thus differing

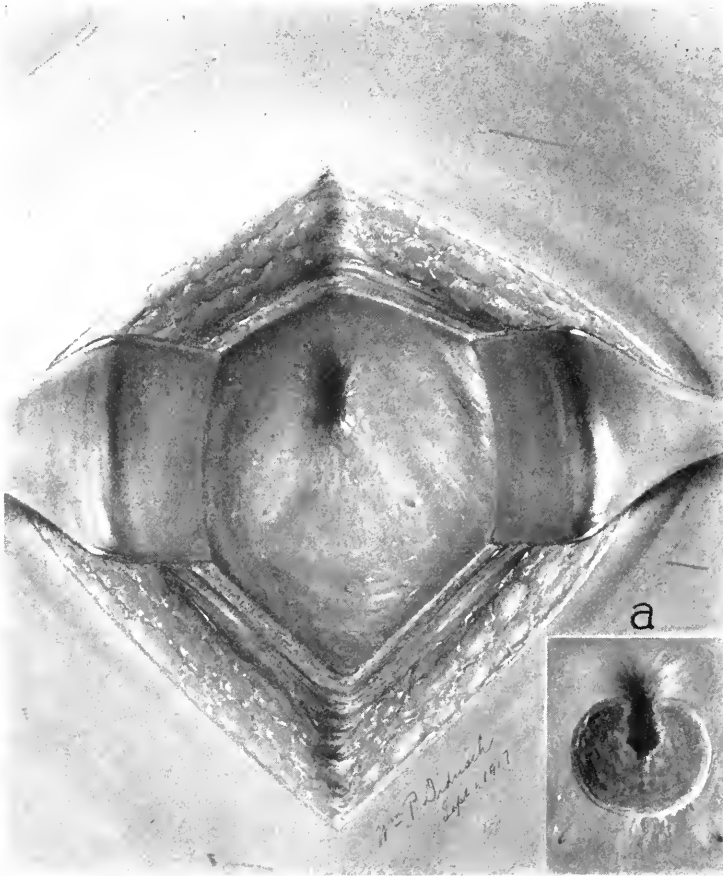


FIG. 1. VIEW OF BASE OF BLADDER SHOWING DILATED INTERNAL VESICAL SPHINCTER

Insert (a) shows area denuded of mucous membrane, preparatory to suturing

radically from the problem presented in cases of epispadias with incontinence which are due to failure of coaptation or muscular development along the roof of the urethra, both at the vesical neck and in the region of the triangular ligament and external

sphincter. The condition present in these cases is shown in figures 8 and 9, and careful examination convinced the author that, in order to restore the vesical neck and obtain a radical cure of the incontinence with complete restoration to normal



FIG. 2. THE NEEDLE HAS ENTERED THE TISSUE AND RETURNED, POINTING TOWARD THE OPERATOR

Assistant hooks suture in eye of needle. (In deep wounds it is necessary to carry the suture down to the needle with a special forceps.)



FIG. 3. "BOOMERANG NEEDLE HOLDER"

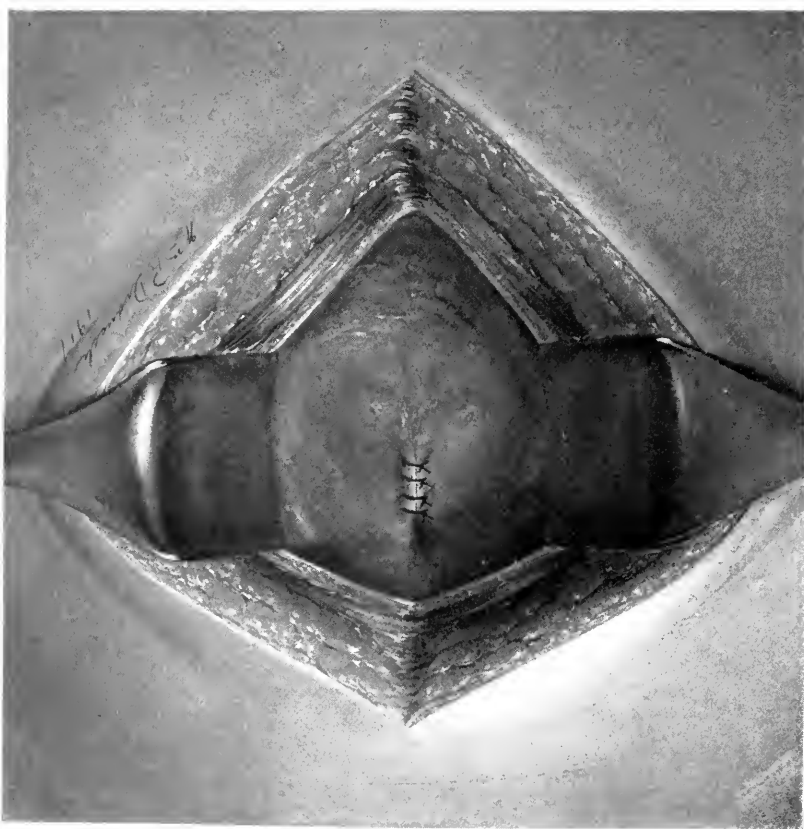


FIG. 4. SUTURE-LINE AFTER COMPLETION OF PLASTIC OPERATION UPON INTERNAL SPHINCTER

urination, it was necessary to attack the roof of the urethra and carry out a plastic to repair completely the internal and external sphincters. This has been satisfactorily accomplished, as will be shown in the two cases which follow. In both of these cases the primary operation was suprapubic and intraurethral to cure the incontinence and later the plastic operation upon the epispadias by the technique described by the author (16).

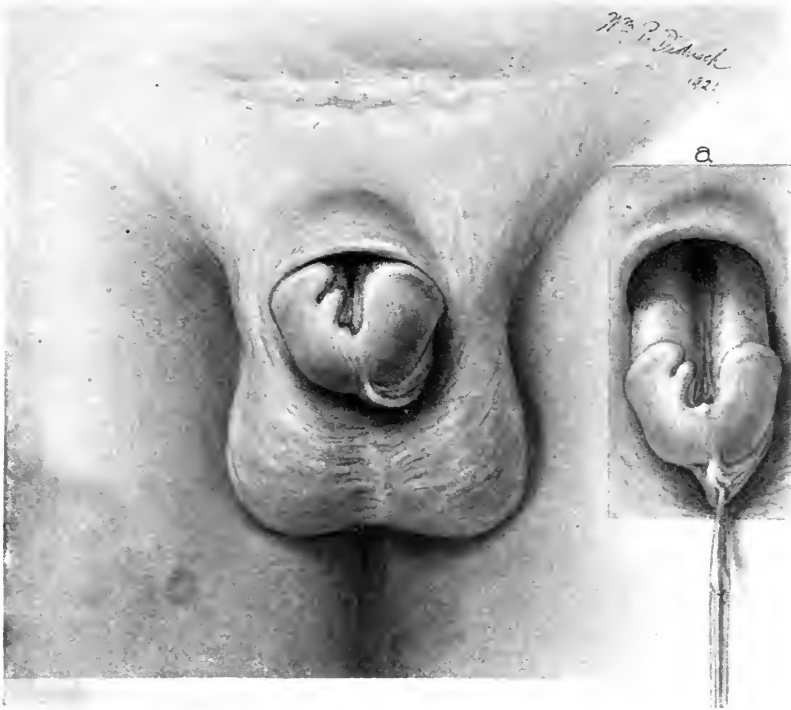


FIG. 5. SHOWING THE EPISPADIAS IN CASE 1

Glans and shaft pulled down to show the great depth of the defect. Glans is only partially cleft.

*Case 1.* No. 8583 BUI, V. W. C., eighteen years old, single. Admitted March 3, 1920.

Complaint: Deformity of penis and incontinence of urine.

Family history: Negative.

Patient was born with deformity of penis and incontinence of urine. At the age of fourteen he underwent an operation for epispadias which

was entirely unsuccessful. Patient has never attempted sexual intercourse although he has erections. No history of venereal disease. In recent years owing to a constant leakage of urine and the resultant odor the patient has had to quit school.

Examination: Patient is a strong, well-developed, healthy looking young man. Heart, lungs and abdomen negative. Suprapubic regions negative.



FIG. 6. SECTIONAL VIEW TO SHOW THE DILATED PROSTATIC ORIFICE (INTERNAL SPHINCTER) AND MEMBRANOUS URETHRA (EXTERNAL SPHINCTER)

Genitalia: Complete epispadias is present, penis being directed upward and lying against the pubis. Serotum is normal in size and testes, epididymes and cords are normal. Penis is broad and along the dorsum there extends a fairly deep groove which represents the urethra. The roof of the urethra is absent for a distance of about 2 inches and beyond that is in the form of a deep funnel which extends down into the bulbous urethra; the corpora cavernosa are partially separated by the troughlike



urethra. The urethral groove extends down through and almost completely divides the glans into two halves. The penis is short, broad and curved upward on the pubis. The prepuce is divided and is redundant upon the under surface of the glans on each side. The condition present is shown in the drawing (figs. 5 and 6). By drawing the penis out by the scrotal hood a deep funnel-like urethra is seen in front of the symphysis pubis and into this the finger can be inserted, showing a distinctly dilated external sphincter. Rectal: Anal sphincter is normal, prostate is smaller than normal, median furrow and notch wide and shallow. Each lateral lobe is approximately the size of the distal phalanx of the index finger. The seminal vesicles are apparently normal and somewhat distended.

Cystoscopy: Cystoscope enters easily, no stricture, no residual urine, bladder capacity 175 cc. Tonicity good. When more than 175 cc. of fluid entered the bladder the fluid escaped around the shaft of the instrument, showing definitely dilated sphincter. The ligamentum inter-uretericum is concave and less developed than usual. The ureteral ridges are thin but fairly prominent, orifices apparently normal. The trigone is apparently less muscular than usual. The uvula vesicae is distinctly less prominent than normal. Cystoscope can be drawn out into the posterior urethra and shows a dilated internal orifice; verumontanum is apparently larger than normal and on the left there is a fairly deep depression in front of the median portion of the prostate. Study of the prostatic orifice shows a dilated orifice and an absence of the usual sharply defined margin. The bladder mucosa is apparently normal. No cellulæ or diverticula. Study of the region of the external sphincter not very satisfactory, apparently somewhat dilated. Urethroscopy shows a definite dilatation of the internal sphincter and imperfect closure of the external sphincter. X-rays show a separation of more than 1 cm. of the symphysis pubis (fig. 7). Preliminary study: Patient complained principally of incontinence which was present almost always night and day. An attempt was made to dilate the bladder and to try to teach the patient to control his urine by exercises; under this treatment the bladder was dilated from 175 to 230 cc. and the patient seemed to gain some control but it was, at best, imperfect and he frequently wet the bed at night and his clothes during the day time. Accordingly it was decided to carry out an operation to relieve the condition.

October 8, 1920: Operation, Young Nitrous-oxide, oxygen, ether. Suprapubic cystostomy and discovery of dilated internal sphincter. Excision of roof of urethra in prostatic and membranous portions. Plas-

tic operation to restore a normal internal prostatic orifice, internal sphincter and external sphincter. An incision was made in the median line about 5 inches long and the bladder widely opened and an excellent view obtained. The prostatic orifice was widely opened as



FIG. 7. X-RAY SHOWING MARKED SEPARATION OF THE SYMPHYSIS PUBIS (1.5 CM.)

A little thorium remains in the bladder after previous examination

shown in figure 8a. The entire prostatic urethra was apparently markedly dilated and there was no evidence of sphincteric action present, the tissues in front of urethra were thin and fibrous. On each side and posteriorly apparently there was muscle present. A finger in-

served into the posterior urethra passed without difficulty out through the external sphincter and another finger inserted through the epis-padias into the bulbous urethra easily met the finger which had been

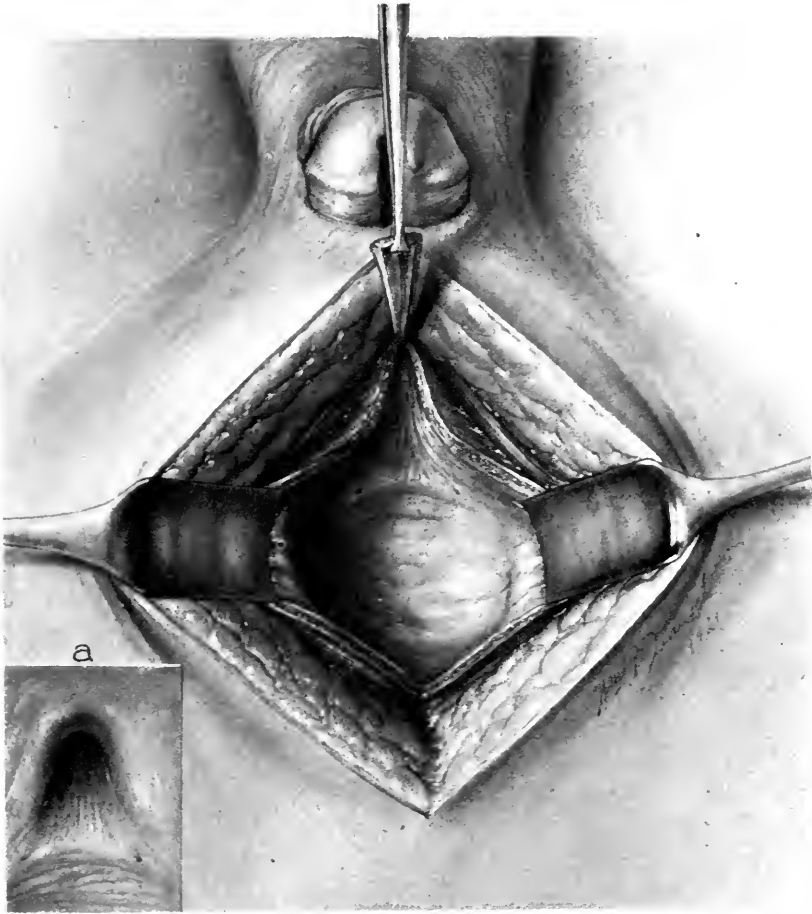


FIG. 8. (a) DILATED CONDITION OF PROSTATIC ORIFICE AND ATROPHY OF THE TRIGONE

Excision of anterior wall of dilated prostatic urethra also shown

passed from the bladder outward, thus showing marked dilatation, not only of the prostatic urethra but of the membranous urethra and external sphincter. Investigation showed little or no "triangular ligament" and the absence of musculature in front of the urethra in the bulbo-

membranous region. The trigone was distinctly atrophic in appearance but the ureteral orifices looked normal. The operator decided to confine his attention to curing the incontinence and thought it necessary to attack not only the internal sphincter and vesical orifice but the external sphincter as well. Accordingly the anterior wall of the prostatic urethra

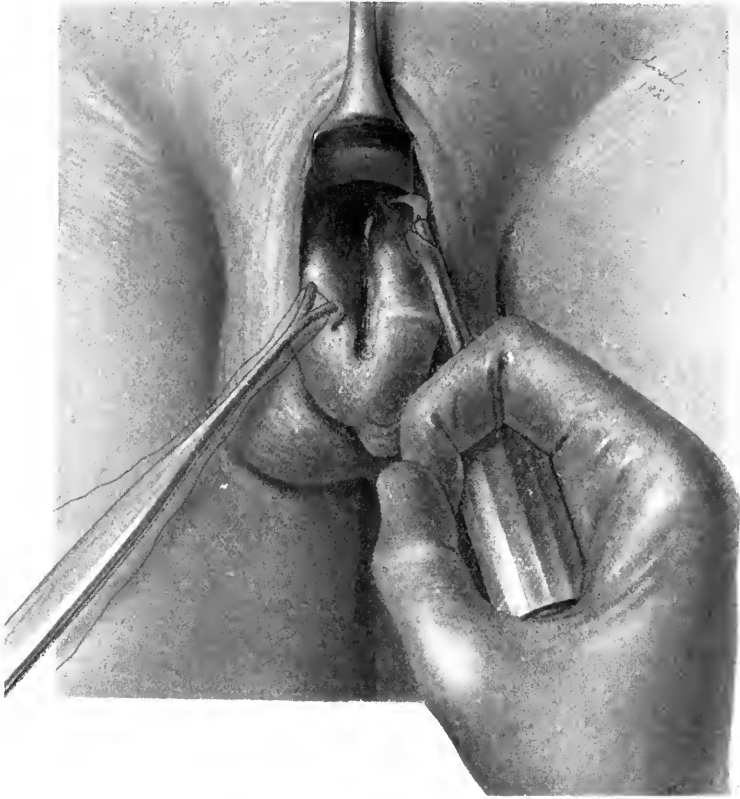


FIG. 9. THE ROOF OF MEMBRANOUS URETHRA EXCISED THROUGH EPISPADIAC CAVITY

was excised as shown in figure 8. The adjacent portion of the anterior wall of the bladder was also excised so as to leave sufficient tissue which when closed would form a fairly normal prostatic urethra. Examination showed that there was muscle on each side which could be drawn together. There still remained the dilated external sphincter and it was found possible by inserting a narrow retractor to obtain a good view of

the roof of the membranous urethra through the epispadias and dilated bulbous urethra. A clamp was then inserted, grasping the roof of the urethra, and with a delicate knife the mucous membrane and adjacent tissues were excised along the roof of the membranous urethra until the

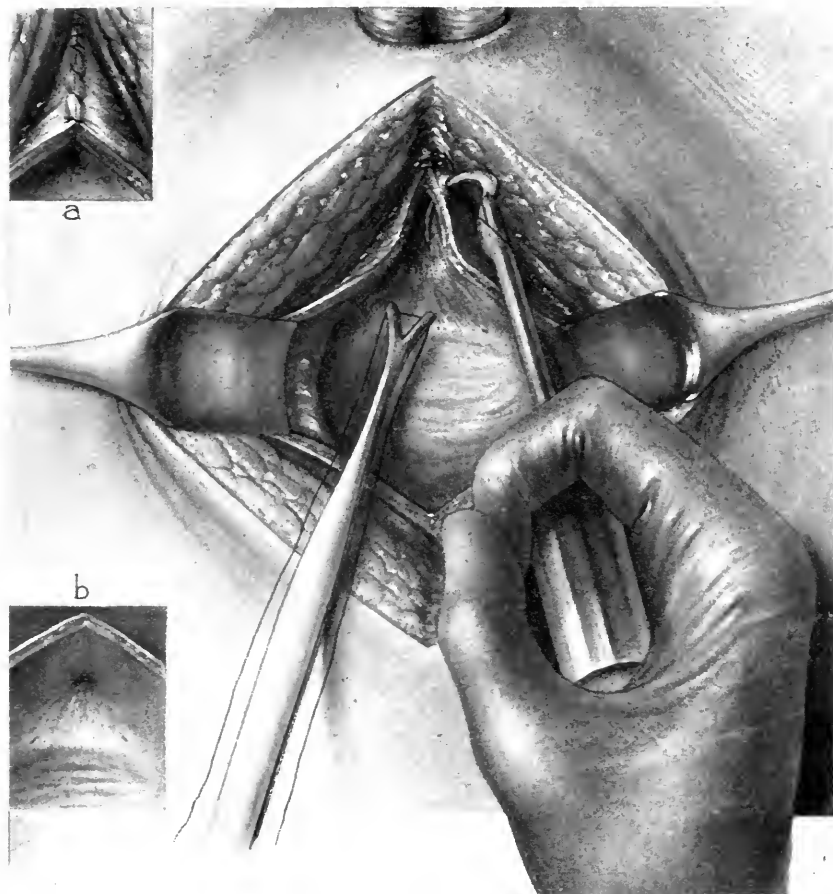


FIG. 10. SHOWING THE APPROXIMATION OF CUT EDGES OF PROSTATE WITH "BOOMERANG NEEDLE HOLDER" AND RESULTANT CLOSURE OF PROSTATIC ORIFICE

region of excision which had been carried out suprapubically was reached; in this way the entire roof of the prostatic and membranous urethra had been excised (figure 9). Through the suprapubic wound by means of a continuous chromicized catgut suture, which did not pene-

trate the mucous membrane, the prostatic urethra was closed, the muscle approximated at the vesical orifice and a tight internal sphincter produced. By a continuation of the same suture the adjacent anterior



FIG. 11. APPROXIMATION OF ROOF OF MEMBRANOUS URETHRA WITH CONSEQUENT CLOSURE OF THE EXTERNAL SPHINCTER

wall of the bladder was approximated (fig. 10). The view obtained then in the bladder was that of a normally closed prostatic urethra whereas previously there was a funnel-like neck which extended into the urethra. By means of the "boomerang needle holder" a suture of chromicized catgut was placed in the roof of the membranous urethra through the

epispadias and dilated posterior urethra, as shown in figure 11. Investigation showed that the membranous urethra was tightly approximated. The bladder was closed with the continuous chromicized catgut suture, leaving an opening at the upper angle for catheter drainage. The recti muscles and skin were drawn together with interrupted silver wire sutures with prevesical drain at the lower angle, catheter drainage for the bladder. No operation to close the epispadias was done at this time.

Comment: The plastic operation to secure approximation similar to normal closure of the prostatic and membranous sphincters was apparently entirely satisfactory.

Convalescence, October 12: Patient has done well, suprapubic drainage satisfactory. One per cent mercurochrome injected in small amounts into the bladder and bulbous urethra. No evidence of infection. October 19: Patient has done well, drains freely through suprapubic tube. Mercurochrome instillation daily. October 23: Suprapubic tube has been removed but the patient voids through the penis and has partial control. October 30. Catheter replaced in suprapubic sinus and attached to Davis vacuum bottle. December 7: Patient has had an excellent convalescence, suprapubic drainage has been maintained in view of second operation. At times the patient has voided urine in fair amount through the urethra and has apparently complete control.

December 8, 1920: Operation, Young. Nitrous-oxide, oxygen, ether.

Plastic operation to repair and cure epispadias. The technique followed was similar to that previously described by author (16). Incisions were made on each side so as to give abundant tissue for a large urethra (figure 12). At the posterior angle the incision went down into the depths of the cavity towards the bulbous urethra and the skin on each side was elevated freely. At the glans penis the incision on the left extended only a short distance on the anterior surface of the glans, the new urethra being left continuous with the skin of the glans. On the right side the incision was carried deeply through the substance of the glans to the inferior surface so as to bisect the glans and displace the urethra to its normal position. The corpora cavernosa were widely separated by an incision to the right of the new urethra and after this had been approximated by continuous chromicized catgut suture and reinforced by a second line of continuous sutures, the urethra was depressed between the corpora cavernosa (fig. 13), the left corpus being rotated with it and two corpora then held in place above the new

urethra by a continuous line of chromicized catgut sutures. Another line of continuous sutures was placed to draw together the skin along the dorsum and the foreskin was drawn together with an additional con-

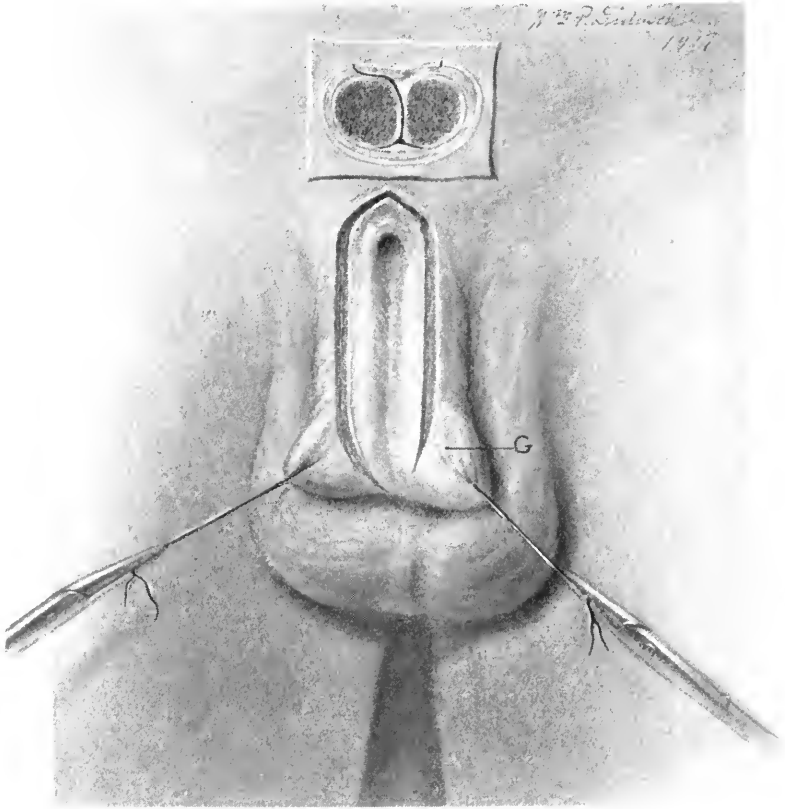


FIG. 12. SKIN INCISION

The penis is held in position by two traction sutures placed in glans (G). As indicated by the dark black line in the diagrammatic cross section, the incision on the left side goes only through the skin and down to the corpus, while, on the right, the dissection is carried down between the corpora until the skin of the under surface of the penis is reached.

tinuous chromicized catgut stitch. The glans penis was approximated above the new meatus with interrupted stitches of chromicized catgut (fig. 14). At the upper angle of the wound the tissues were not entirely approximated, a space being left for escape of serum.



Remark: At the end of the operation the penis looked quite normal, the glans was well formed and the tissues were well approximated. The suprapubic drainage was continued.

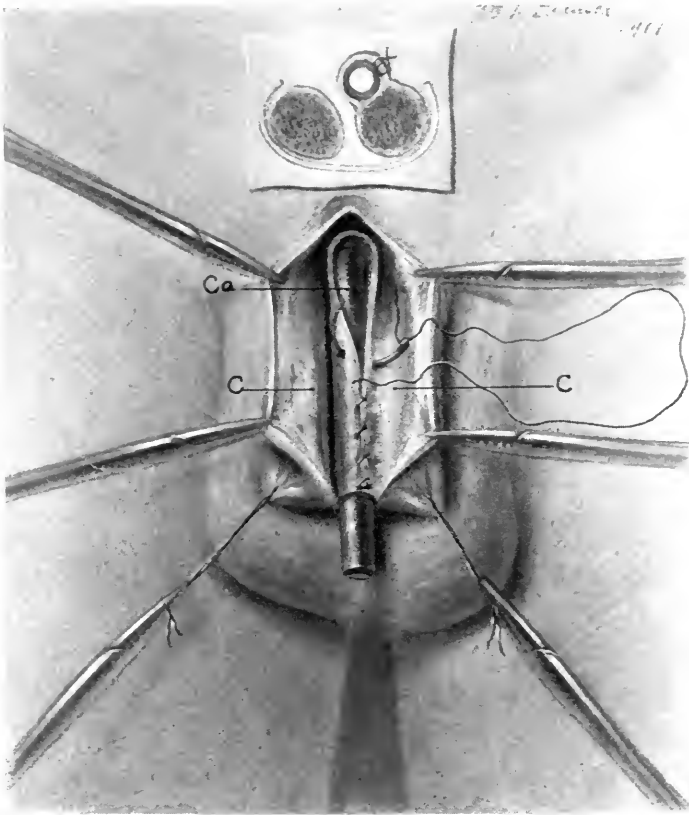


FIG. 13. THE NEW URETHRA IS BEING FORMED BY A CONTINUOUS SUTURE, BRINGING TOGETHER, OVER A CATHETER (Ca), THE EDGES PRODUCED BY THE ORIGINAL INCISION, AND CONVERTING THE ORIGINAL GROOVE INTO A TUBE

The attachment of the urethral tube to the left corpus may be distinctly seen both in surface view and cross section.

Convalescence. December 11: Patient had a chill followed by a rise of temperature to  $105^{\circ}$ . Examination showed slight edema of penis but no definite infection was made out. December 13: Patient has continued to have slight fever and pus can be expressed from the new

formed meatus. Injections of a small amount of 1 per cent mercurochrome have been carried out several times daily. December 18: Temperature has become normal and suppuration has ceased. Wound has not broken down and condition is excellent. December 28:

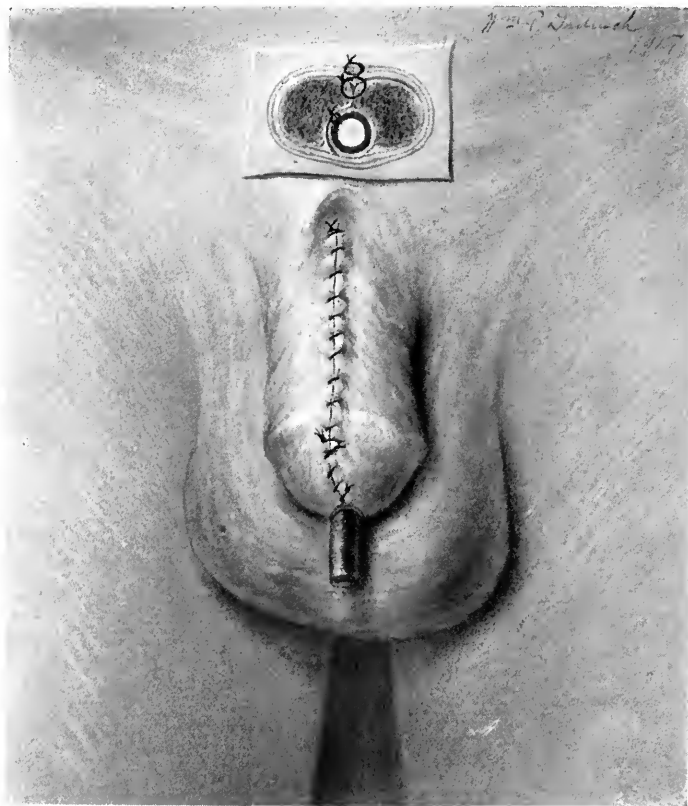


FIG. 14. THE OPERATION COMPLETED

The two outer edges of the original incision were easily brought together in the midline making a penis and glans almost normal in appearance.

Suprapubic drainage has been entirely satisfactory. The plastic operation has healed everywhere except at the root of the penis where tissues were not closed. Urethral suppuration has ceased. General condition excellent. January 10, 1921: Suprapubic drainage continued, occasionally patient is able to void through the new formed urethra and has

good control. January 30: Urine escapes from a small fistula at the base of the penis. Filiforms show a stricture or division of the urethra



FIG. 15. RESULT SEVEN MONTHS AFTER CURE OF EPISPADIAS

No fistula, no stricture, perfect urinary control, sexual powers normal

about an inch from the new meatus. After some difficulty filiforms and followers are passed and urethra is well dilated. February 11: Sounds

again passed through the new urethra. Suprapubic sinus completely closed. Patient voids urine freely, good stream and has complete control. February 15: Excellent condition maintained, further dilatation carried out. Patient able to void normally about every four hours. Fistula at base of penis almost healed. No. 22F sound passed



FIG. 16. CONDITION SEVEN MONTHS AFTER OPERATION

with ease. General condition excellent. Patient has complete urinary control. On erection the penis is straight, upward curvature has practically disappeared. Patient is discharged.

May 17, 1921: Patient returns for observation. He is able to retain urine all night and for normal intervals during the day. He drinks water in considerable quantity and passes as much as 300 cc. at a time.

He has complete control and even when the desire to urinate is strong he is able to hold urine until he can walk to a convenient place to void. Libido, erections and sexual powers are quite normal. Intercourse frequent and entirely satisfactory. Ejaculations apparently normal in every respect.

Examination: The condition present is shown in the accompanying drawings (figs. 15 and 16). As seen here, the glans is normal in appearance with the exception of a small scar along the corona in the median line above. The prepuce is redundant on each side beneath the glans. The dorsum has been completely restored and the corpora cavernosa approximated in their proper position in front of the urethra, which lies along the inferior surface of the penis. The patient passes urine freely in large stream, has perfect control and urine is sterile. He states that the organ on erection is about 4 inches in length and coitus normal.

Comment: The result obtained here is to be considered quite ideal and justifies us in feeling that at last a satisfactory procedure has been discovered for the complete cure of these severe deformities associated with the most distressing condition, incontinence of urine.

In another case, operated upon previously, a similar procedure was carried out. This case is as follows:

*Case 2.* No. 7677 BUI, L. H. Age nine years. Admitted April 23, 1919.

Complaint: Deformity of penis. Incontinence of urine.

Family history: Negative. No history of miscarriages or deformities.

Past history: Negative with the exception of deformity of the genitalia which has been present since birth and which has always been associated with incontinence of urine, both by day and by night. Urine escapes without his knowledge and is not associated with any pain or discomfort in the urethra, bladder or kidneys. He has otherwise been entirely well.

Examination: Patient is a well-developed, well-nourished boy of nine years, weighing 60 pounds. He is fairly robust in appearance and the heart, lungs and abdomen are quite negative. Suprapubic region negative. Groins negative.

Genitalia: Scrotum and testicles are apparently normal and well-developed. Penis presents an extreme degree of epispadias. Penis: the typical picture of complete epispadias is present with a continued

leakage of urine which constantly escapes through the trough-like urethra. The superior gutter-like depression does not completely divide the glans penis and the corpora cavernosa are coapted for a short distance beneath the gutter which is deeper than in the case described in my operation for the cure of epispadias. The foreskin, as usual, lies in loose folds on each side of the glans penis. When the penis is drawn outward and downward the deeper urethra appears as a deep pocket with a hooklike fold of mucous membrane above. Instruments are easily passed into the bladder and there is no constriction or obstruction of any sort but the urethra is apparently dilated in the region of the deep urethra. Plain X-ray shows a wide separation of the symphysis pubis, but on examination no failure of coaptation is made out. Cystogram with bladder filled with thorium shows a pear-shaped bladder with a funnel-like neck. Urine: cloudy, acid reaction, microscopically numerous short bacilli, but no pus.

Comment: The surgical problem presented here was first incontinence and secondly epispadias. Examination seems to indicate a dilated or relaxed vesical orifice; it seems wise, therefore, first to carry out an exploratory suprapubic cystostomy with the hope of curing the incontinence and then in a subsequent operation to attack the epispadias.

May 9, 1919: Operation, Young. Nitrous-oxide, oxygen, ether. Suprapubic cystostomy. Plastic operation to restore vesical sphincter and cure incontinence, suprapubic drainage. Division of glandular urethra preliminary to a subsequent epispadias operation. The bladder was opened in the median line extraperitoneally and an excellent view was obtained. Instead of the usual tight prostatic orifice, the urethra was widely open and it was easy to see the verumontanum in the floor of the urethra, the posterior urethra being a funnel-shaped part of the bladder. Examination failed to show any evidence of internal sphincter, examination with the finger in the urethra seemed to indicate that the external sphincter was present and the operator, therefore, decided to direct his attention to the internal orifice and sphincter. Accordingly the urethra was divided in the median line anteriorly as far as the triangular ligament and external sphincter and then with scissors a wedge-shaped strip was excised on each side including a part of the anterior wall of the bladder and of the roof of the dilated prostatic urethra on each side. This excision of tissue extended down to the region of the triangular ligament and external sphincter. Examination showed that there was muscle present on each side whereas in the

median line the tissues had been largely fibrous external to the urethral mucous membrane. The cut edges were approximated with interrupted heavy chromicized catgut sutures which did not include the mucous membrane and were tied externally. A catheter which had been passed through the urethra into the bladder was then removed, and examination showed that the internal urethral orifice was tight and the tissues well approximated. The anterior wall of the bladder was closed by a continuous chromicized catgut suture which did not include the mucosa. A drainage tube was brought out of the upper angle of the vesical wound, no urethral drainage being provided. The suprapubic wound was then closed with interrupted silver wire sutures for muscles and skin with a small gauze prevesical drain. The gutter along the roof of the penis which did not extend through the glans penis was then prolonged by dividing the glans deeply thus bringing the gutter to the end of the penis preparatory to a subsequent operation.

Remark: At operation a good view of the anterior bladder was obtained, the trigone and ureters seemed about normal but the vesical orifice was so greatly dilated that the verumontanum was easily seen and the tissues of the roof of the posterior urethra were very thin and fibrous. It would seem, therefore, that there had been failure of coaptation of the muscular and probably glandular structures of the prostatic and vesical neck, in other words that the foetal defect which produces the epispadias extends back to the bladder. Operation was very successful in producing a tight vesical orifice.

Convalescence, May 15: Suprapubic drainage has been successful but the patient has complained of much pain in the region of the bladder. May 18: Davis suction apparatus applied, condition satisfactory, much less pain. May 26: Vesical drainage continued. The incision in the dorsum of glans is kept open by adhesive so as to allow the mucous membrane to grow along the line of incision and form a gutter continuous with that between the corpora cavernosa. No urine escapes through the penis. May 30: Suprapubic catheter removed, patient voided a small amount of urine through the penis at intervals. June 4: Suprapubic fistula has been closed completely for three days, patient voiding at intervals through the urethra. June 8: Urine contains pus and bacilli. Vesical instillations of mercurochrome 1 per cent twice daily begun. June 12: Patient voids urine at intervals and apparently has good control, only occasionally slight lack of control.

June 14: Patient now can retain urine for three to four hours, voids freely and has good control. Urine still cloudy with bacilli and pus.

Patient is discharged in excellent condition. To return next year for epispadias operation.

Second admission, May 2, 1920: Patient's condition has improved during the past year. He is now able to retain urine for five to six hours, has no incontinence at night or during the day, voids freely, good stream. The epispadias is still present, the furrow in the glans is deeper than before previous operation but not sufficiently deep. Corpora cavernosa are partly separated by the urethral trough but are partly attached to each other beneath. Urine is acid in reaction. Sp. gr. 1016, free from infection and pus. General condition excellent. No suprapubic scar. Previous operation has been entirely successful in curing the incontinence.

May 5, 1920: Operation, Young. Nitrous-oxide, oxygen, ether. Perineal urethrotomy, insertion of catheter into the bladder for drainage. Plastic operation to cure the epispadias, following author's technique (16).

Before carrying out the plastic to cure epispadias the urethra was opened in the perineum and a catheter inserted in the bladder and fastened to the skin with sutures so as to provide drainage and avoid urinary soiling of plastic operation.

In this case the urethral trough was deeper than in the previous cases, the corpora cavernosa were not quite completely separated and the furrow in the glans was shallow. First an incision was made in the midline above the base of the penis and by blunt dissection the deeper portion of the bulbous urethra was exposed and freed in front and on each side, thus furnishing a deep tube about an inch in length. In front of this point the urethra was in the form of a gutter along the superior surface of the penis. Incisions were then made on each side to the median line leaving an abundance of tissue adjacent to the gutter to form a new urethra of ample size. On the right side the incision was carried deeply through the tissue of the glans until near the posterior surface. On the left side the incision in the glans was only extended about half this distance. Glans penis was then divided into two halves. On the right side the dissection along the gutter was continued backward until the corpora cavernosa had been completely separated. On the left side the mucous membrane was left attached to the inner surface of the left corpus cavernosum to insure a good blood supply but the edge was sufficiently freed to be drawn over the catheter and sutured to the opposite side to form a spacious new urethra. A continuous chromicized catgut mattress suture (Cushing type) was used, an excellent



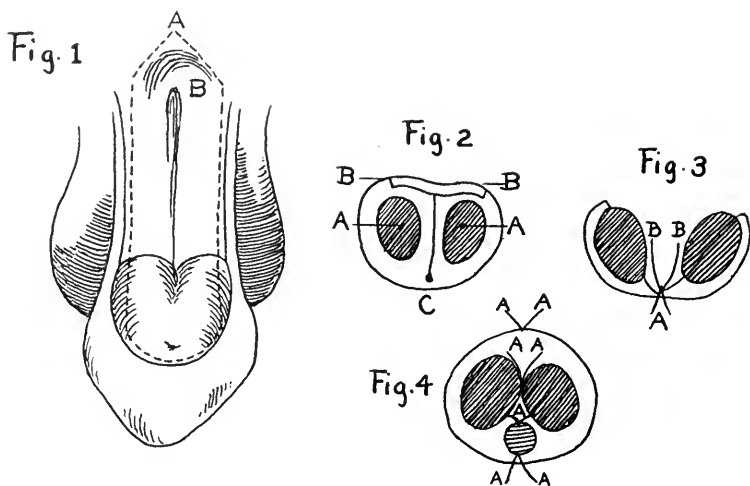
approximation and inversion of the skin obtained, a second line of stitches to reinforce the first line of sutures was used, also continuous chromicized catgut. The corpora cavernosa were then drawn together above the new formed urethra which had been depressed into its proper position along the inferior surface of the penis. The divided glans penis was then approximated in front of the urethra which then presented a normal appearance along the inferior surface everywhere and a fairly normal looking glans was produced. The skin along the dorsum was then drawn together with a continuous chromicized catgut suture which extended back almost to the root of the penis, a small area being left open near the symphysis pubis for escape of serum. The catheter around which had been placed was then removed. Patient stood operation well and was in good condition at end of operation. The plastic result was apparently very satisfactory.

Convalescence, May 8: Patient has been comfortable. Urinary drainage through perineal catheter quite successful. May 11: The scrotum has become very edematous and red. May 12: Scrotum less swollen and condition is improved. May 15: Condition improved, healing of plastic satisfactory, except in region of glans which is slightly broken down. Scrotal swelling completely subsided. May 22: Catheter removed. Sutured wounds healing satisfactorily. May 26: Perineal wound almost closed, patient voids urine at intervals in good stream through the new formed urethra. June 9: It is now thirty days since operation. Wound has healed well. Urethra is satisfactory and lies on the inferior surface of the penis. Meatus is small. Penis is somewhat irregular and not entirely normal in appearance but the functional result is good. Patient has complete urinary control, voids freely at intervals of four hours. Urine is sterile and free from pus. Patient has had no instruments passed. General condition is excellent. Patient is discharged, to return subsequently for examination.

May 15, 1921: The patient's father writes that the boy is able to retain urine for four hours during the day and all night. There is no fistula present and no instruments have been passed since the operation. His general health is very good.

Comment: The results obtained in this case have been almost ideal, in that there was not only restoration to normal position of the external urethra (beneath the corpora cavernosa and glans), but also a complete cure of the incontinence. The technique adopted for the repair of the vesical neck and the cure of the epispadias were completely justified.

In commenting upon the procedure too much stress cannot be laid upon the great importance of excising sufficient mucous membrane and all other tissues along the roof of the urethra so that when the lateral stitches are drawn together, a sufficiently



### Cantwell's Method.

FIG. 17

1. The dorsum of the penis in a complete epispadias. A, the dotted line represents the line of incision for urethral flap. B, the infundibulum or opening into the bladder.

2. A transverse section of an epispadias. A-A, the corpora cavernosa. B-B, a transverse section of flap composed of urethra, and, if necessary, the remains of the corpus spongiosum. C, the line of incision between the corpora cavernosa down to the skin on the under surface of penis.

3. A transverse section of an epispadias showing the cavernous bodies separated. The urethral flap (B-B) laid on the gutter and a retention suture (A) in place.

4. Transverse section of penis after operation showing the sutures (A, A, A, A) in place.

tight vesical orifice will be obtained. What we require is a tonically closed orifice which will be opened only by contracture of the trigone in the voluntary voiding of urine. The procedure by which normal micturition is accomplished, which was just

described by the author in 1919, has been presented again in extenso by Dr. M. B. Wesson, (17) who has furnished, by most careful embryological studies, the proof of the relation between the trigone and the vesical sphincter in opening the vesical neck to allow the escape of urine, and by Young and Wesson (18). The process of micturition is not (as so long held) merely an inhibitory dilatation of the internal sphincter or vesical neck with expulsion of urine by vesical contracture, but a definite pulling open of the vesical orifice by muscular contracture of the trigone. In both of these cases, the trigone, from non-use since birth was atrophic and the musculature less definite than normal. These cases seem to show, however, from the complete restoration to normal micturition which has been obtained, that trigonal muscle after years of non-use can functionate normally when the vesical neck has been restored to a condition of normal closure by a plastic operation, as carried out in the radical operation above outlined.

It may be well here to refer again to the author's technique for the cure of penile epispadias, which was presented in 1917 (16) and which has now been employed in five cases with excellent results. In no case has there been any sloughing of the transplanted mucous membrane which forms the new urethra, as has been reported after Cantwell's operation (fig. 17). The plan of leaving skin tube attached to one corpus cavernosum so as to insure proper blood supply and also to aid contracture and subsequent retention to its position beneath the corpora cavernosa on the inferior surface of the penis has been completely justified, and in all of these cases has furnished a technique by which it has been possible to completely cure the defect in one operation and to produce a practically normal penis.

#### CONCLUSIONS

1. Simple epispadias can be repaired very satisfactorily by a technique described by the author in 1917 (16).
2. In cases associated with incontinence of urine there is a muscular defect along the roof of the deep urethra associated

with dilatation of the vesical orifice and the urethra in the region of the external sphincter.

3. To obtain a radical cure of the incontinence and restoration to normal urination the plan proposed, namely, to excise the superabundant roof of the urethra and restore the vesical neck and external sphincter by sutures, is justified by a report of two cases in which perfect results have been obtained.

My thanks are due to Wm. P. Didusch for much assistance and excellent drawings.

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## TREATMENT OF MALIGNANT DISEASE OF THE PROSTATE AND BLADDER<sup>1</sup>

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### PART I

In the past twenty years, there have been registered in the Urological Department of Johns Hopkins Hospital approximately 450 cases of cancer of the prostate. It was the development of the surgery of the prostate which was responsible for the recognition of the frequency of cancer, the pathologist in most instances making the diagnosis for the surgeon.

The frequency with which cancer of the prostate is associated with hypertrophy caused considerable confusion in the clinical diagnosis. In a study made some years ago, in 75 per cent of the cases of cancer, there was an associated prostatic hypertrophy or there had been a previous adenoma present replaced subsequently by cancer. When a prostatic adenoma is invaded by cancer, it is possible to tell from the architecture of the gland that there has been previously present adenomatous tissue. In 25 per cent of the cases, the cancer was unassociated with adenoma. In a pathological study made some years ago, I was able to show quite conclusively that when cancer of the prostate was associated with adenoma, the cancer always began in the posterior lobe or in the portions of the prostate not involved in the adenomatous process. The examination of the material from several hundred cases of adenoma showed that in not a single instance was cancer found in the adenomatous lobes, except where it occurred as a direct invasion of the cancer in the posterior lobe.

<sup>1</sup> Read at the meeting of the American Association of Genito-Urinary Surgeons, Richmond, Va., May 2-3, 1921.

Our experience in subsequent years has entirely substantiated the accuracy of these earlier studies. This pathological study explained also the apparently confusing evidence which palpation of the prostate and cystoscopy furnished in many cases. Rectal examination of these cases revealed a prostate definitely carcinomatous, while on cystoscopic examination the picture was typical of benign hypertrophy. In the average cases the diagnosis is not difficult, as the induration, irregularity, the formation of an intervesicular plateau, the extension of the process into the seminal vesicles or toward the membranous urethra are typical of malignancy of the prostate. The changes are not infrequently associated with marked contracture of the prostatic urethra.

Cancer occurs in the same period of life as prostatic adenoma, so that the age of incidence is of little value in the differential diagnosis. Unfortunately, cancer of the prostate seldom produces symptoms until the disease is far progressed. Urinary symptoms, as a rule, are not produced until the vesical orifice or prostatic urethra becomes extensively involved, leading to their contracture. In occasional cases symptoms resulting from metastases are present before the onset of any urinary obstruction.

In early cases of cancer, the patient usually presents himself, not because of symptoms produced by the cancer, but frequently because of symptoms of urinary obstruction resulting from adenoma. In rare cases early cancer is recognized where examinations are made as part of the routine physical examination. In nearly every instance, however, when the patient is first seen, the disease has advanced to the posterior bladder wall or into the region of the seminal vesicles, rendering radical extirpation impossible. In only twenty-one cases out of four hundred was the cancer found confined to the prostate and it was considered possible to excise all of the cancerous tissue. In fourteen cases the radical operation of Young was carried out, and in the remaining seven of the cases a total prostatectomy was done. In this latter group, the growth was well confined to the prostate, thus making possible its complete extirpation without necessitating the removal of the seminal vesicles and neck of the bladder.

It is of interest to note that in all of these cases in which a sub-total prostatectomy or complete removal of the prostate with its capsule was carried out, there has been no recurrence of the disease. It should be noted, however, that in all of these cases, it was possible to remove the cancer with a wide margin of healthy tissue. Young has reported in his series of fourteen radical operations a cure of 50 per cent, but this operation is limited in its application to those cases in which the disease has extended only slightly beyond the prostate.

In our experience in 95 per cent of the cases surgery alone is hopeless so far as complete extirpation of the malignant disease is concerned. Therefore, if we are to obtain a greater percentage of cures, some other form of therapy must be developed, which will secure results, either alone or in combination with surgery. With our present available methods of treatment, the most that we can hope to accomplish is the relief of urinary obstruction or the prevention of its development. Forty per cent of the cases when first seen have either complete retention or obstructive symptoms with a large amount of residual urine. In many of these cases the symptoms resulting from urinary obstruction are distressing and some procedure must be employed to give relief. In 60 per cent only slight or no residual urine is present, and the patient has presented himself principally because of frequency or painful urination. In many of these cases, the symptoms are aggravated and largely produced by an accompanying cystitis.

### *Radium therapy*

The promising and often enthusiastic reports of the value of radium in the treatment of malignant disease promoted our use of radium in cancer of the prostate. This work was begun in 1915. Since that time, radium has been employed alone or in combination with operation in one hundred fifty cases. Up to eighteen months ago radium was used exclusively through the urethra and per rectum against the prostate and seminal vesicles. A platinum capsule containing 100 mgm. of radium was applied for one hour, this being repeated every second or third day, the radium being applied each time at a separate point so that the

applications would overlap as little as possible, and thus minimize the possibility of irritation. From ten to fifteen hours were given per rectum and about five hours per urethram this constituting the first series of treatment. Usually at the end of this time, in many cases considerable rectal irritation was produced, the patients having quite frequent stools with the passage of considerable amounts of mucus. With the first appearance of these symptoms, treatment was discontinued and the patient was asked to report in about two months for a second series. It was usually found in the second series that the amount of radiation which the patient would tolerate without producing marked rectal irritation was distinctly less than in the first series. If possible, some months later the patient was asked to return for a third series. In about 25 per cent of the cases which received 2000 to 2500 mgm. hours per rectum rather distressing rectal symptoms were produced.

Examination of the rectal mucosa in these cases shows a marked thickening and edema with considerable congestion. In some cases ulceration has been noted. The duration of these symptoms after the cessation of treatment usually continues for several months and occasionally for six months or longer. In certain cases developing symptoms of rectal irritation, following the first series of radiation, the resumption of treatment after the disappearance of rectal symptoms is rapidly followed by severe and protracted irritation. In occasional cases the appearance of rectal symptoms is rapidly followed by severe and protracted irritation. In occasional cases the appearance of rectal irritation is delayed for several months after treatment has been discontinued. Local measures directed toward the relief of symptoms have been of little value. Starch enemata have afforded a certain relief in some cases. In our earlier experience in the treatment of these cases per rectum, several very severe radium burns were produced. In one of these a colostomy was carried out because of rectal obstruction, resulting from the intense edema of the rectal tissues. In the other cases the same procedure was done because of severe ulceration with accompanying pain and tenesmus.



During the past eighteen months, we have been needling the prostate in combination with applications per urethram and per rectum. The needles are inserted through the perineum in the manner advocated by Barringer, 12.5 or 20 mgm. needles of radium element being employed, these being left in the prostatic tissue from fifteen to thirty hours giving a total radiation of from 500 to 1000 mgm. hours at each treatment. The urethra receives a series of radiations totaling about 500 mgm. hours, with about 1000 mgm. hours are given per rectum. One advantage in employing the needles is that it brings the radium in intimate contact with the cancerous tissue and decreases the amount of radiation given per rectum and per urethram, thus decreasing the danger of irritation.

Examination of the prostate after the first series of 1500 to 3000 mgm. hours of radium treatment, usually showed a marked change in the character of the prostate. While it was occasionally decreased in size, the most marked change noticeable was in the consistence of the gland. Instead of being stony hard, it was now rather elastic and of a consistence of hard rubber. The change was frequently so marked that one would not recognize the prostate as cancerous. Although these marked changes occurred in the size and consistence of the prostate, the seminal vesicles seemed usually very much more resistant and the induration persisted there a much longer period of time. While one could not deny the marked change which occurred in the character of the prostate, this change tending to make one rather enthusiastic in the beginning, *it soon became evident that the relief of obstructive symptoms was not proportional to the apparent change in the prostate. In very few cases in which complete retention or a large residual was present was there any relief of obstructive symptoms.* In many of the cases in which the amount of residual decreased or the retention was relieved, the results could frequently be attributed to the use of an intermittent or retention catheter, or to the urethral dilation which the application of the radium entailed. Barringer, in several reports which he has made concerning his experience with cancer of the prostate, has obtained almost identical results. Because of the failure to relieve

obstruction in these cases of large residual or complete retention, prostatectomy was carried out in a considerable series, and it was possible then to say to what extent the radium had affected the cancer tissue.

In most cases in which a considerable amount of radium had been employed, the cancer tissue showed microscopically a marked change. Over large areas one would find a complete disappearance of epithelial cells, the connective tissue framework still persisting. In other areas the cancer cells appeared to be shrunken and almost unrecognizable, while in blocks made from other points, the cancer tissue was well preserved. In every case operated upon distinct cancer tissue, apparently unchanged, could be found in areas notwithstanding the amount of radiation previously employed.

*The failure of radium to secure relief of obstruction when there is complete retention or a large residual urine except in a small percentage of cases will necessitate the employment of other procedures to secure this result. A part of the failure to secure functional results can be attributed to the fact that in a large percentage of cases the carcinoma is associated with hypertrophy, the radium having little or no effect on adenomatous lobes.*

The value of a modified perineal prostatectomy in relieving the obstructive symptoms, even in advanced cases of cancer of the prostate, has long been realized in our clinic.

Of the two hundred fifty cases of cancer of the prostate seen in the Urological Clinic up to the year 1915, in one hundred of these perineal prostatectomy was carried out. In 75 per cent of these there was no return of obstruction up to the time of the patient's death, many of these patients living a number of years. Of these one hundred cases, there was an operative mortality of 3 per cent. In seventy cases it has been possible to secure information concerning the duration of life. Sixteen of these lived less than six months, fifteen between six months and a year; twelve between one and two years; ten from two to three years, and seventeen three years or more. Of these seventeen cases, nine lived between three and four years. Of the remaining eight cases, two lived about four and one-half years, two six years, two nine years and two fourteen years.

The average time of closure following operation differs not at all from the time of closure in the benign hypertrophy cases. In seven cases, a fistula persisted up to the time of death. In none of these one hundred cases, in which prostatectomy was carried out, was anything more than relief of obstruction contemplated, and there was no attempt or thought of eradicating the disease. The low mortality and the relief of distressing obstructive symptoms secured by this operation, relief in the majority of cases extending up to the time of death, is a sufficient justification for this operative procedure.

When a patient presents himself with an advanced carcinoma of the prostate, a large residual urine or complete retention, he is prepared for prostatectomy in a manner similar to that used where prostatectomy for benign adenomas is contemplated. The operation is, of course, not advised where there is advanced cachexia or where the condition of the patient is such that a very short period of life is expected. In such cases palliative measures are adopted to secure for the patient as great comfort as possible. In such cases, except in dire necessity, operative procedures are not carried out.

### *Technique*

The patient is placed in an exaggerated lithotomy position and the membranous urethra exposed according to the technique employed by Young in perineal prostatectomy. In many cases the membranous urethra will be found markedly thickened because of the extension of the cancer to the peri-membranous tissue. The extension adds but slight difficulty to the proper opening of the membranous urethra which is carried out on a sound. The introduction of the tractor will be found difficult in many cases, because of the extreme contraction of the urethra, and its introduction will necessitate frequently marked divulsion of the prostatic urethra, to aid its insertion. A straight tractor such as was devised by Wilder will be found easy of introduction in these cases. Usually the levator muscles and rectum will be found quite adherent to the posterior lobe of the prostate, and an attempt to secure a dissection as is carried out in exposing the

benign prostate, will lead to serious danger of rectal injury. To obviate this complication the following procedure should be employed: The levator muscles are dissected back from a small area at the apex of the prostate and a short "V" shaped incision is made into the prostatic tissue at this point, enabling one to carry back the levator muscle and rectum with a substratum of cancer tissue attached to them. From this exposure of the prostatic cancer, by means of a sharp curet aided by scissors or rongeur, the center of the prostate is removed, usually en more-cellment. As the cause of obstruction is usually the contraction of the vesical orifice or formation of lobular carcinomatous masses at the level of the sphincter, extreme care should be employed to remove most of the tissue from this area. The curettage or enucleation should be continued until a widely dilated vesical orifice is obtained. In some cases when the cancer is associated with adenomatous lobes, the interior of the prostate can be enucleated in one piece or in large masses. After the obstruction has been relieved a large tube is introduced into the bladder through the opening in the membranous urethra and apex of the prostate. Hemorrhage is controlled by gauze packed around the tube. Needles containing radium element or emanation are now inserted into the shell of cancer which has been left. Special preference should be given to the neighborhood of the vesical orifice when this is extensively involved. A radiation equivalent to 1000 mgm. hours is usually employed. This amount has not been followed by any marked symptoms of irritation or any evident systemic toxic symptoms. It is of interest to note that the hemorrhage where this technique is employed is rarely severe and easily controllable by slight packing. The hemorrhage on the average is distinctly less than in the cases of benign hypertrophy and the shock connected with the operation carried out by the above technique is no greater than that associated with the ordinary external urethrotomy.

There is a fair-sized series of case in which the growth has advanced to the posterior bladder wall and base of the seminal vesicles, too far for complete extirpation by the radical resection of the neck of the bladder, vesicles and prostate. In a series of

five cases in this group, the writer has carried out a radical operation which consists in complete removal of the prostate and seminal vesicles without the destruction of the internal sphincter (see plates 1 to 8). In these cases it is possible to remove practically all of the cancer except a slight extension on the posterior bladder wall.

In view of the definite action which radium has on cancer of the prostate when used over a long period and in sufficient quantities, it seemed to me possible that after the removal of the main mass of cancer tissue, radium therapy might cause complete disappearance of the small areas of cancer which would remain behind. In this small series, after complete removal of the prostate and seminal vesicles, radium was placed in position back of the bladder and beneath the vesical orifice, a total of 600 to 1000 mgm. hours being given in one application. In none of these cases was there any marked irritation produced by the radium. Of these five cases, two died within a year of metastases, one had a local recurrence, and two are living and well for a period of three years. These two cases, on rectal examination, show no evidence of carcinoma.

Results obtained by a comparatively radical operation, combined with radium therapy, would seem to indicate the possibility of radical cure in a larger number of cases than could be accomplished by any operative procedure alone.

### *Summary*

The results obtained in the treatment of cancer of the prostate by various procedures or combination of procedures would seem to indicate the following:

Where the cancer is localized in the prostate and has not invaded the posterior bladder wall and seminal vesicles, the radical operation advised by Young is definitely indicated, provided the age of the patient is not too great or there are not present other contra-indications rendering a radical operation extremely dangerous. Where complete extirpation can be accomplished, a large percentage of ultimate cures can be anticipated, as, at this stage of the disease, metastases rarely occur.

The operation, however, will not have a wide application until earlier cases of cancer are seen by the surgeon. Where the malignancy is confined to one lobe and has not invaded the posterior bladder wall, but is well confined to the prostate, complete extirpation of the lobe or lobes, including the capsule, has resulted in permanent cure in six cases in which this procedure was carried out.

The technique of complete extirpation is very little, if any, more difficult than the ordinary perineal prostatectomy. *In the series of cases in which marked obstruction or complete retention is present, the functional results obtained by radium therapy have been disappointing notwithstanding the marked change which frequently occurs in the prostate and vesicles.* In practically all of these cases, the disease is so far advanced that we can hope for nothing except relief of symptoms, and radium alone apparently does not accomplish this in a sufficiently large percentage to warrant the employment of radium alone. Where marked obstruction or retention is present, a conservative perineal prostatectomy gives excellent functional results with a very low mortality. If carried out with the technique described above, the procedure will not be found difficult, nor will it be attended by any serious complications such as recto-urethral fistula, etc. Closure of the wound will be almost as rapid as following a simple urethrotomy.

At the time of operation, after sufficient tissue has been removed to relieve the obstruction, radium needles are inserted into the cancerous tissue. After the closure of the wound, the patient receives a series of radium treatments with the idea of delaying a subsequent development of obstruction.

In about 50 per cent of cases, operative procedures will be unnecessary as little or no obstruction to urination is present. Radium probably will prove extremely valuable in this group of cases, not so much for the cure of the cancer as in preventing the development of urinary obstruction later. In practically all of our cases in which slight or no obstruction was present when the patient was first seen and in whom radium was employed, no serious obstruction later developed during the life of the patient.

While radium has not accomplished all that was hoped for in the cure of cancer of the prostate, it still has a very definite field of usefulness. Its chief field of application will apparently prove to be in that group of cases which have advanced cancer without urinary obstruction in helping to prevent the development of urinary obstruction with its attending distressing symptoms. Radium cannot be considered as replacing operative procedures but in many cases serving only as a valuable adjunct in the treatment of cancer of the prostate. Obviously the application of radium to the prostate can have no influence on the pains due to metastasis.

## PART II

The introduction of the cystoscope, making possible the early diagnosis of bladder tumors, has enabled the surgeon to attempt their excision. Until the cystoscope began to be employed there was no diagnosis of bladder tumor made in the Johns Hopkins Hospital except where a suprapubic cystotomy was done because of intolerable bladder symptoms, the operator not infrequently finding a bladder filled with cancer.

With the possibility of early diagnosis with the aid of the cystoscope, the surgeon began to direct his attention to the destruction or excision of these vesical neoplasms. At first, through a suprapubic exposure of the bladder the removal of these tumors was accomplished principally by means of clamp and cautery or by destruction with the cautery alone. A favorite measure was to place a clamp across the pedunculated tumor and then with the cautery blade cut across the pedicle. The more extensive infiltrating growths were cauterized with varying degrees of intensity. The surgeon soon found, however, that practically no results were obtained where the growths were infiltrating and extensive, and that notwithstanding his greatest care in the removal of the more pedunculated and localized growths, he almost invariably, or at least in the vast majority of instances, had to contend with subsequent recurrences. It was frequently noted that where originally there had been only one tumor, the surgeon subsequently found the bladder studded with recurrent

growths, and not infrequently the suprapubic tract itself became the seat of implanted tumor. Sometimes a second and third suprapubic excision was carried out, but the end result was always the same and each succeeding operation found conditions worse.

In 1909 in the symposium before the International Congress, the vast majority of surgeons had about come to the conclusion that patients, as a rule, live longer without operation; that operation was only advisable where there was a definite carcinoma which could be resected, and that only in such cases should surgery be attempted. The results obtained by most surgeons were so discouraging that very few recommended operation with any degree of enthusiasm. The surgeon had no difficulty in thoroughly and effectively destroying the pedunculated papillary tumor. He could not prevent however its recurrence, and when this resulted, he had no means other than surgery to remove it.

While removal of the superficial or pedunculated papillary tumors could be successfully carried out by means of the cautery, it soon became evident that this was not an efficient means of removing infiltrating growths. In the infiltrating type of tumor the radical removal of the area of bladder wall involved was the only treatment which was followed by satisfactory results. It was the common experience of the surgeon that when he resected for malignant growths, this procedure being more or less limited to definite cases of cancer, local recurrences were less frequent than in those cases in which comparatively benign and seemingly innocent tumors had been destroyed by the cautery. This has been our experience. This difference of opinion was so striking that some surgeons boldly advocated that resection, where at all possible, should be carried out in every case of vesical tumors.

While surgeons were obtaining such poor end results, Nitze, by means of his ingenious operating cystoscope was securing results incomparably superior to anything that surgery had up to that time accomplished. He first secured pieces of tumor for microscopic examination, and if the tissue proved to be cancerous, he did not attempt its removal endovesically. If, however,



the tumor was not cancerous, he removed it by this means. The percentage of tumors which he was able to remove through his operating cystoscope and his end results compare almost identically with results obtained by the methods employed today. Apparently the type of tumor which we can today remove by means of fulguration he succeeded in destroying by means of his ingenious cauteries and wire snares. With the introduction of fulguration by Beer in 1910 a new era in the treatment of bladder tumors was begun. The excellent results obtained in certain tumors and failure of the treatment in others led to very careful histologic studies and it soon became evident that fulguration was only effective in benign and malignant papilloma and that it failed to remove the true papillary or infiltrating carcinoma.

In a study made some years ago, we were able to show a recurrence in 40 per cent of the cases within a period of three years. In all these cases the primary tumor had been completely and entirely removed by means of fulguration. The great majority of the recurrences were observed within the first year. In thirty-one of our cases in which papillary tumors had been removed by suprapubic cauterization, recurrences were noted in twenty-five; of the six remaining cases, no recurrence was present in six months in two; one was well two years; one three years; one five years and one ten years. The patient who was free of recurrence for ten years developed, some months later, a small papilloma on the right lateral wall which responded promptly to fulguration. He had no recurrence two years later. It can be seen from these figures that recurrence following removal by means of fulguration is distinctly less frequent than following suprapubic removal of the same type of tumor. Furthermore, it has been our experience that where the primary tumor has been removed by means of fulguration, the recurrent tumor, if seen early, will respond to this treatment. The results obtained by fulguration in the tumors suitable for this form of treatment are really so encouraging that little more can be expected, and the results are incomparably superior to any result which can be obtained by operative procedure. About 40 per cent of all cases of bladder

tumor presenting themselves in our clinic belong to the benign or malignant type suitable for fulguration. This, it is apparent, leaves a great many tumors unsuitable for this form of therapy.

### *Radium*

In 1915 we began the use of radium in the treatment of bladder tumors. Practically all tumors, whether papilloma or carcinoma, were subjected to radium therapy. It was soon found that all of the papillomata responded to radiation and disappeared with varying amounts of treatment, depending upon the size of the tumor.

### *Technique*

By means of a special cystoscope 100 milligrams of radium were carried into the bladder which was previously distended with fluid, and then under direct vision the radium was placed against the tumor mass. It was usually left in position for one hour and the treatment was repeated about every second or third day. The frequency and the period of duration of any one treatment naturally varied somewhat with the tolerance of the individual. This accurate placing of the radium against the tumor mass is very essential, because to effect the tumor favorably and cause its disappearance, frequently required more radium than would ordinarily be sufficient to produce a severe burn of the normal bladder mucosa. This can largely be avoided by accurately placing the radium directly against the tumor and keeping the normal bladder wall distant by means of a quantity of fluid in the bladder cavity. We have in some instances given 2000 to 3000 mgm. hours to infiltrating growths without seriously affecting the surrounding bladder mucosa.

Early in our work, it was found that some papillary tumors which seemed extremely resistant to fulguration treatment, responded very promptly after a small amount of radiation. Consequently, it has been a habit in our clinic to radiate most tumors, even those which subsequently will be treated by fulguration.

Radium has been employed in the past six years in our clinic in 150 cases of bladder tumor, either alone, in combination with fulguration or operation. It has been found that radium will destroy all papillary tumors which will be affected by fulguration. It is rather interesting to note that in one case with multiple tumors on the trigone, most of which disappeared under intensive radiation, one seemed to be resistant, and withstood enormous doses of radium over a period of many months. This tumor, although apparently withstanding intensive radium treatment, when subsequently fulgurated, responded most promptly and disappeared as quickly as the ordinary benign papilloma. We have no explanation of this peculiar resistance.

Our results with radium in the treatment of extensive infiltrating carcinomas have been most discouraging. Although in many instances, many hundred milligram hours of radium application were given directly over the tumor area, in no instance was the tumor, which was distinctly infiltrating, cured by radium therapy. Ofttimes, very malignant looking tumors, which were apparently only slightly infiltrating have disappeared under the radium action.

About 50 per cent of all tumors occur in the region of the ureteral orifices where infiltration, if present can be detected by rectal palpation. In not a single instance in which a tumor associated with induration, which could be detected on palpation, has there been a disappearance of the tumor or a cure of the tumor effected.

During the past six months, following the suggestion of Barringer, in cases in which resection is not feasible, we have been opening the bladder and implanting emanation tubes deeply in the tumor tissue. So far, our results have been discouraging. It is only fair to say, however, that all of these cases in which this form of therapy was adopted were very extensive. In no case so far, in which we failed to effect the cure of tumor by intensive surface application to the tumor area, have we succeeded in curing it by infiltration with emanation or multiple radium needles. Our experience, however, is too limited to draw any positive conclusions regarding the benefit to be derived from this

procedure. Although radium in our hands fails to effect a cure in the extensive infiltrating growths, there is a large group of papillary carcinoma in which only superficial infiltration is present, which are satisfactorily handled with radium. Frequently these tumors are multiple or creep superficially along the mucous membrane surface spreading over large areas. This is a group of tumors which will not respond to fulguration and are mostly inoperable. When the bladder is opened suprapubically in this type of case and an attempt made to destroy the tumor or tumors, recurrence and implantations are most apt to occur. It is in this group of tumors in which radium has given us our most brilliant results—a group of tumors in which fulguration fails and surgery is useless. In these tumor cases it is inadvisable to open the bladder, and we have found it preferable to direct the radium therapy against the surface of the tumor, accurately placing the radium on the tumor surface itself. In this particular group, recurrences are frequent and rapid, and one has to treat frequently recurrences in these cases at short intervals over a period of several years. In one such case, at least fifty tumors were removed during a period of two years. The patient now has had no evidence of recurrence during the past six months.

*Tumors anterior to vesical orifice*

It has been our experience that tumors in this location should receive surgical treatment, no matter to which group they belong, because it is impossible with any of our present cystoscopes to treat accurately and apply therapy to tumors in this position. In at least three instances we have allowed tumors which apparently in the beginning were comparatively benign, to go on to infiltrating carcinoma before it was discovered that this had occurred. I would recommend very strongly where tumors are partly visible in this position to institute surgical removal. If the tumor is papillomatous, it can be destroyed with the cautery or resection can be carried out. Tumors in this position are not suitable for endovesical treatment and are extremely favorable for operative treatment.

*Metastases*

It is surprising to what extent tumors of the bladder may progress without the recurrence of metastases. We have been astonished in many cases with extensive malignant tumors of the bladder dying, because of sepsis, renal or some intercurrent disease, to find no demonstrable metastases. In twenty-seven cases of bladder tumor coming to autopsy, in which the growths were extensive and true carcinoma, in only three was the pathologist able to demonstrate metastasis. The slowness and the late date of occurrence of metastases would bespeak an attempt at radical operation, even in very extensive tumors, where it is at all possible to remove the local growth. If the local growth be removed, the prognosis from a metastatic standpoint will apparently be good. In three of our cases the primary tumor disappeared very promptly and rapidly under the influence of fulguration. The patients were seen from time to time and no evidence of re-formation of papillary tumor was noted. One of these patients developed subsequently at the site of the former tumor what was apparently a severe cystitis, the mucous membrane being very red, uneven and in places slightly ulcerated. The other two patients developed similar mucous membrane changes but at a point far removed from the original tumor, in both instances being in the opposite half of the bladder.

*Case I.* This patient, a male, aged forty-seven, was admitted March 16, 1916, the cystoscopy showing a large papillary tumor back of the right ureteral orifice. This was vigorously fulgurated on three occasions which resulted in a rapid disappearance of the tumor. It was the operator's impression that the tumor belonged to the benign type of papilloma. Subsequent examinations showed the mucous membrane at the site of the former tumor to be quite edematous, very red and somewhat uneven. In August, 1916, five months after the disappearance of the tumor, recurrence was noted behind the right ureteral orifice. This was smooth and there was slight tendency to sloughing. Some edema of the mucosa adjacent to the tumor was also noted. About 200 mgn. hours of radium were applied to the tumor, which disappeared quite rapidly. Examination four months later showed considerable reddening and edema of the mucosa at the site of the recurrence. No tumor,

however, was visible, and rectal examination showed no induration of the bladder wall. The patient was next seen in July, 1917, at which time the edema of the mucosa was still present without any definite tumor being noted. Rectal examination at this time, however, showed a great deal of induration in the region of the right seminal vesicle and the base of the prostate.

*Case 2.* Patient, male, aged fifty-five, was first seen in March, 1916. Cystoscopy showed an irregular papillary tumor back of the left ureter. This was fulgurated and rapidly disappeared. Examination seven months later showed the region of the bladder occupied by the original tumor to be normal. Back of the right ureter there was noted a localized area about 2 cm. in diameter in which the mucosa was red, edematous and uneven. There was no evidence of tumor. The area gradually increased in size and it finally became apparent that there was present a carcinoma in the bladder wall beneath the mucosa, there being no projecting tumor. Although radium was applied directly to the area the spread of the disease was not controlled and the entire bladder wall gradually became involved.

*Case 3.* Patient, male, aged forty-four, was first seen in November, 1914, complaining of frequency and burning on urination. On cystoscopy there was found in the region of the left ureter three papillomatous masses, the largest being about 3 cm. in diameter. External to the right ureter the mucosa was extremely red and slightly elevated. This was thought to be an area of localized cystitis. The tumors around the left ureter were fulgurated and promptly disappeared. Three months later the area had increased considerably in size. A rongeur specimen obtained from this area showed superficially a chronic inflammatory process, while the deeper part of the section was typical cancer. Radium applications were made to this area without checking the spread of the disease, the entire bladder gradually becoming involved.

The last two cases cited would seem to indicate that it is possible for metastasis to occur in the bladder wall at some distance from the primary tumor as well as immediately beneath the tumor. There seems no plausible explanation of the carcinoma beneath an infected mucosa unless we admit that this represents a metastasis.

An observation, similar to the three cases cited above, has been made in a case treated with radium. A large papillary tumor

back of the left ureter disappeared under application of radium. A few months later, at the site of the original tumor, there was noted some reddening and ulceration which was at first thought to be a radium reaction. It was subsequently discovered that this apparent radium burn was really an infiltrating tumor of the bladder wall, presenting a picture similar to the cases cited above. These cases represent a metastasis to the bladder wall. While many cases of very extensive cancer of the bladder occur without there being present demonstrated metastases, in occasional instances very small pedunculated papillomata may result in metastases. In three of our cases in which small papillary tumors were destroyed by fulguration, and in which no recurrence of the tumor was noted in the bladder, bone metastases subsequently developed. One metastasized to the femur, one to the clavicle, one to the spine. In a limited number of cases it seems that the tumor may metastasize to the bladder wall itself.

Buerger has reported a case in which an apparently innocent pedunculated tumor removed by resection showed in the bladder wall metastatic cancer cells. A similar case has been observed by us. This patient, a man aged 50, had a large papillary tumor on the left postero-lateral wall just back of the trigone. Histologically the tumor was a definitely malignant papilloma, and there was no evidence cystoscopically of infiltration of the bladder wall. The tumor disappeared under a series of radium treatments, leaving a slight reddening and irritation of the mucosa at the site of the former tumor. About two months after the tumor had disappeared, the patient was killed in an automobile accident. Autopsy revealed a normal bladder with the exception of slight ulceration and reddening at the site of the former tumor, evidently the effect of the radium. There was no visible evidence of tumor. Histological sections made from this area showed a superficial zone of inflammation but no surface tumor. In the muscular layer, however, there was discovered a small nest of typical cancer cells, which was undoubtedly metastasis, there being no other evidence of tumor.

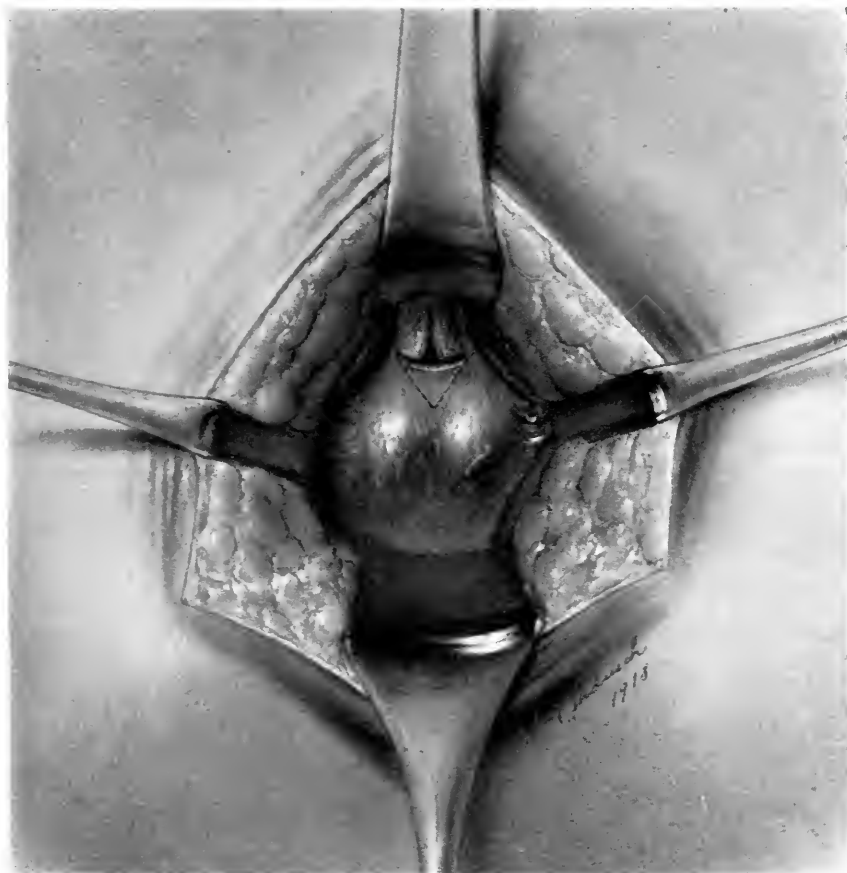
*Summary*

Fulguration should be the method of choice in all benign and malignant papillomata which can be reached by endovesical means. Where the tumors are resistant to fulguration or are papillary carcinoma, non-infiltrating or superficially infiltrating, radium will give uniformly good results, and the results will be obtained by surface applications to the tumors. Where the tumors are deeply and distinctly infiltrating but sufficiently localized so that resection could be carried out and the growth removed with a definite healthy margin of tissue, this procedure should be employed and radium therapy not depended upon. Where, following the removal of the growth, the operator feels that possibly he has not given sufficient margin at any one point, radium should be inserted in the contiguous tissue. In the very extensive cases of carcinoma in which it is impossible to satisfactorily carry out endovesical treatment with radium, it is our custom now to open the bladder suprapubically, destroy as much as possible of the tumor or tumors with the actual cautery, and then implant radium emanation tubes approximately at 1 to 2 cm. distant from each other. What is to be expected from radium applied in this way in these perfectly hopeless cases it is too soon to pass judgment. So far, our results in these otherwise hopeless cases have not been very brilliant.

## PLATE 1

The prostate has been exposed and the membranous urethra opened. The urethra is now divided, the dotted line indicating the line of incision on the anterior urethral wall.





## PLATE 2

A cross section of plate 1. The dotted line indicates the line of excision of the prostate and seminal vesicles.



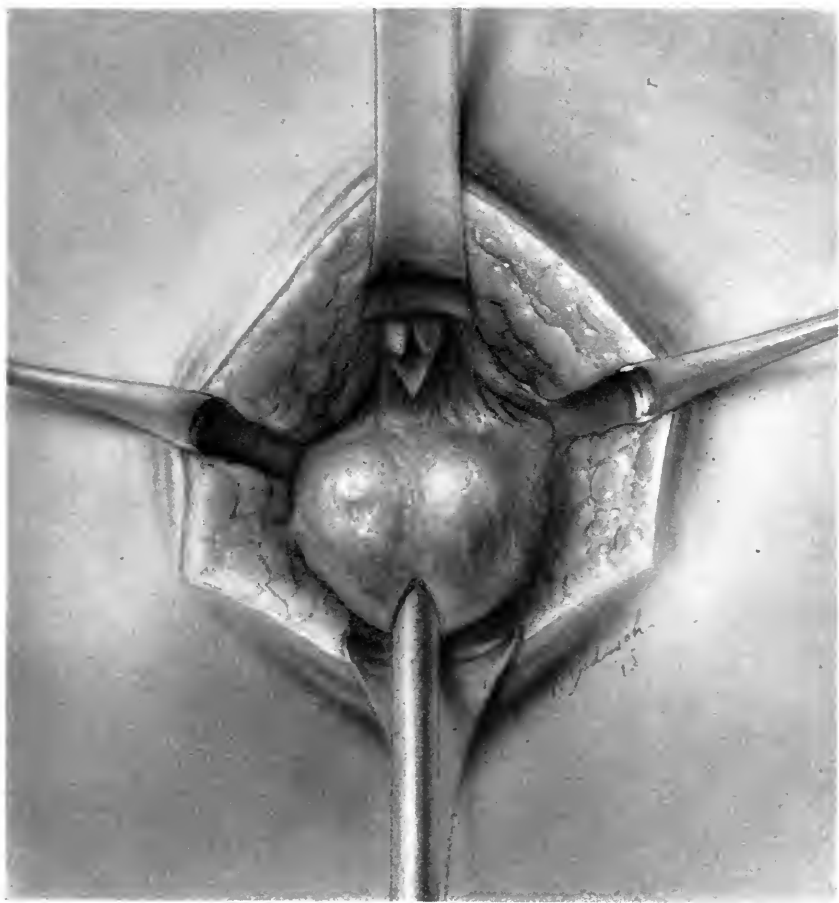
### PLATE 3

The urethra has been divided, the prostate drawn downward and the freeing of the anterior surface of the prostate begun.



#### PLATE 4

The prostate is pulled downward and its anterior surface freed up to the point of its attachment to the bladder wall.



#### PLATE 5

The prostate has been separated from the bladder, this being easily accomplished. The anterior commissure has been divided and the prostate freed from the tractor. In this instance the vesicles and vas are not removed.





PLATE 6

Showing complete prostatectomy with seminal vesiculectomy.



PLATE 7

Cross section showing end of divided urethra. The prostate and seminal vesicles have been completely removed, leaving the internal sphincter intact.





## CALCIFICATION OF THE SEMINAL VESICLES<sup>1</sup>

HERMAN L. KRETSCHMER

*Chicago, Illinois*

Clinical interest in the subject of calcification of the seminal vesicles is apparently not very great, as evidenced by the scarcity of literature on this subject. As a matter of fact I have been able to find only a few articles dealing with this topic.

The men who would naturally be most interested in this subject would be the pathologists, genito-urinary surgeons, and the roentgenologists yet in textbooks on pathology the subject is briefly dismissed with the statement that calcification in the seminal vesicles does occur, and its possibility is merely mentioned in textbooks on genito-urinary surgery. Moreover, a casual review of the roentgen-ray literature yielded nothing. Prompted by this fact a personal communication was sent to several roengenologists asking them for information on this subject. However, the following roengenologists had never met with this condition: Blaine, Carman, Hartung, Holmes, Manges, Pancoast, Reynolds, Trostler and Waters. On the other hand, Braasch stated that he had seen shadows in the roentgenogram on several occasions which were caused by calcified areas in the tuberculous prostate and seminal vesicles; Pfahler, that he had demonstrated calcification in the vesicles only in 3 or 4 cases which he can recall; and Skinner, that he had seen a few cases. Potter informed me that he had seen small nodular calcifications in cases of genito-urinary tuberculosis which from their distribution suggested they occupied positions in the vesicles.

A case under recent observation merits report for the following reasons:

1. Extensive calcification of one seminal vesicle.
2. The age of the patient (fourteen years).

<sup>1</sup> Read at the annual meeting of the American Association of Genito-Urinary Surgeons, Richmond, Virginia, May 2-3, 1921.

- 3. Problem of diagnosis.
- 4. The rare occurrence of this condition.

Robert E., aged fourteen. In July, 1919 a suprapubic cystotomy for stone in the bladder was performed but no stone found. A diagnosis of stone in the ureter was made and the boy's father was told by the surgeon that he had crushed the stone with his fingers and that the fragments would pass.

The suprapubic wound failed to close, discharging clear urine, as a rule but at intervals pus.

Frequency of urination was present for several years, the patient being obliged to void many times during the day. There was no nocturia but the suprapubic pad was saturated with urine in the morning. Occasionally a few drops of blood were seen in the urine and the abdominal pad showed blood stains. There was a small amount of discomfort in the left side.

Physical examination was negative except for the presence of a slightly enlarged right kidney. Left kidney was not palpable. In the suprapubic area was a scar from his previous operation and in the lower angle of this scar was the opening of his suprapubic fistula, from which urine was being discharged.

Examination of the urine showed albumin positive; no sugar; microscopically, pus cells, red blood cells and bacteria. Examination of the first specimen for tubercle bacilli was negative.

Roentgen-ray examination by Dr. H. E. Potter showed the presence of an elongated, moderately dense shadow about 1 by 3 cm. in the lower pelvic region on the left side. From its position and contour it was believed that the shadow was *not* due to a stone in the ureter. A diagnosis of stone in the ureter having been made previous to patient coming under observation, it was thought advisable to cystoscope him, catheterize the ureters with shadowgraph catheters, and take a second roetgenogram in order to determine, if possible, the origin of the shadow seen on the plain plate.

Cystoscopy showed a mild generalized cystitis. During cystoscopy there was much bleeding. Left ureteral orifice was dilated. Examination of the urines showed the following:

	CELLS	CULTURES	TUBERCULOSIS
Bladder.....	2,560	Staphylococci	Negative
Left kidney.....	23,000	Sterile	Negative
Right kidney.....	90	Staphylococci	Negative



*Roentgen-rays.* The shadowgraph catheter apparently laid in contact with the shadow under consideration (fig. 1). Nevertheless, there being no justification for assuming that this shadow was due to a stone in the ureter, a rectal examination was done with the shadowgraph catheter in place.

*Rectal examination.* Left seminal vesicle was hard in outline, irregular, and corresponded in outline with the shadow seen on the X-ray plate. Palpation showed that a definite interval existed between this hard calcified seminal vesicle and the shadowgraph catheter.

Repeated examinations were made for tubercle bacilli in the urine from the left kidney and all were negative. A diagnosis of pus kidney probably tuberculous, was made and nephrectomy advised.

*Operation (January 17, 1920).* Left nephrectomy was carried out under ether. Ureter was thickened and enlarged. Patient made an uneventful recovery. Examination of the removed kidney showed the presence of tuberculous pyonephrosis.

At the time of cystoscopy a guinea-pig was injected with the urine from the left kidney. In due course of time an autopsy was done; tubercles were found in the spleen and acid fast bacilli in the pus from the large caseous lymph-gland.

The suprapubic fistula failed to close and a subsequent operation was done for the closure of the fistula. The wound has remained dry ever since.

#### TYPES OF CALCIFICATION

Apparently, there are at least two types of calcification which occur in the seminal vesicles. One type may be designated as senile calcification because it occurs in men of advanced years. Cases belonging to this group have been described by George and Chiari.

The second type is the calcification due to tuberculosis. The case reported above evidently belonged to this second group, since the patient was too young to be classified under the type of senile calcification. Further evidence in support of this view was the tuberculous left kidney. From the replies received from Braasch and Potter, it is evident that the cases which they had seen were likewise of the tuberculous group. The case reported by Guelliot also occurred in a tuberculous patient.

It would be well to emphasize here that some of the cases of so-called calcification reported in the literature were in reality calculi in the seminal vesicle; in others, the calcification involved the vas deferens and not the seminal vesicle.

George reported 2 cases several years ago from Chiari's Pathological Institute in Prague. His first case was a male, aged sixty-three, in whom a diagnosis of endocarditis obliterans, gangrene of the first and second toes of the left foot, and traumatic tetanus had been made. The genital organs were without pathologic change except that in the wall of the mesial part of the inferior third of the right seminal vesicle, near the right vas deferens, an oval-shaped mass of bone-like consistence was found. The author stated that it seemed to be a lime salt infiltration.

The second case occurred in a man, aged fifty-three. The anatomic diagnosis was anal fistula, probably tuberculous, peritonitis, icterus, softening of the brain, healed tuberculosis of the lung, peribronchial lymph-glands and tuberculous ulcer of the intestine. The left vas deferens was found to be hard and bone-like in consistence. The left seminal vesicle was normal. The author called attention to the fact that the calcification occurred in connection with chronic inflammation.

Chiari, in 1903, reported a case in a male, aged sixty-eight, who died of lobar pneumonia and chronic nephritis. The ampullae of the vas deferens and seminal vesicles were of stony hardness, hence their removal was attended with difficulty.

According to Chiari, the foci involved chiefly the sclerotic connective tissue and he regards this case as one of focal calcification of the muscularis of the ampullae of the vas deferens and seminal vesicle, developing in previous proliferation and sclerosis of the connective tissue.

Two cases of calcification of the vas deferens were also reported at the same time by Chiari in men of fifty-eight and seventy-five. At autopsy only the ampulla of the vas deferens was found calcified, the vesicles being *intact* and the other genital organs normal.

Fraenkel likewise has reported cases of calcification occurring in the vas deferens. The patients were forty-five, sixty-two,

sixty and fifty-four, respectively. Three of his 4 cases showed evidence of arteriosclerosis, such as areas of atheroma in the coronary arteries and the aorta. These cases were found at autopsy. Roentgen-ray pictures were made of the pelvic organs taken out in toto. The illustrations as given showed very distinctly the presence of calcification of the vasa deferentiae. In one instance the calcification was more pronounced than it was in the other. The seminal vesicles were not involved.

Chetwood operated upon one case supposed to be tuberculosis and discovered that the calcification definitely involved both the seminal vesicles and the prostate. The case was one of very old protracted inflammation involving the prostate, seminal vesicles and adjacent tissues.

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## MODIFICATION OF DIFFERENTIAL FUNCTIONAL TEST WITH PHENOLSULPHONEPHTHALEIN<sup>1</sup>

ANDERS PETERSON

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In the employment of the differential functional test of phenolsulphonephthalein in diagnosis of kidney lesions it has become apparent that its usefulness is often diminished due to the failure of collecting all of the dye excreted by each kidney during the period of observation.

When, in the ordinary case, a number 6 ureteral catheter can be introduced well into the kidney pelvis on each side and free drainage takes place from each catheter there is generally only slight leakage into the bladder (from a trace to 2 per cent of the phthalein) and here the phthalein estimation can be given its full weight in the consideration of the case.

It not infrequently happens that when suitable catheters are inserted traumatic hemorrhage occurs on one or both sides causing poor drainage and here a large amount of the dye is recovered in the bladder specimen. To divide the amount of dye in the bladder specimen between the kidneys can give no dependable data.

Due to anatomical deformity at the ureterovesical junction and to pathological changes in the ureters, catheters of smaller sizes must be employed in the catheterization of one or both sides. Here again marked leakage along the catheters invariably takes place and the differential output of phthalein cannot be accurately determined.

In order to obviate the above stated factors in the use of this very helpful test in the study of kidney lesions I wish to bring before you the consideration of an additional test of the kidney specimen which I have here termed the concentration test of phenolsulphonephthalein.

<sup>1</sup>Read before the Urological Society of Los Angeles, May 3, 1921.

In December, 1917, Krotoszyner and Stevens<sup>2</sup> published their investigations with the use of phlorizin intravenously as a differential functional test. They concluded that the quantitative determination of sugar was of no value but that the comparative concentration of sugar in the specimen from each catheter furnished dependable data regarding renal function. Following the intravenous injection of 0.01 gram of phlorizin sugar appears in the urine in five to seven minutes. The acme of sugar excretion sets in within a few minutes and its disappearance occurs within forty-five minutes after phlorizin injection.

In the early part of 1918 Dr. Kendall, suggested the study of the comparative concentration of phenolsulphonophthalein following catheterization of the ureters. Under the direction of Dr. Braasch a large number of observations were made in the routine cystoscopic examinations and I have since that time made use of the method in my private practice.

The technique of this test is carried out as follows: After ureteral catheterization has been accomplished and specimens collected for microscopic examinations 1 cc. of phthalein is given intravenously, its time of appearance noted and the phthalein collected for fifteen minutes. The bladder specimen is obtained either by having the patient void or drawn by a soft catheter.

An equal number of cubic centimeters (usually 5 cc. or less) of each kidney specimen is now accurately measured into a suitable glass graduate and a few drops of sodium hydrate solution added to each. Each specimen is diluted with distilled water to 200 cc., filtered and read in the colorimeter. The strength of color expressed in per cent represents the concentration of the phthalein excretion from each kidney during the period of observation without reference to the quantity actually excreted and is constant without consideration of leakage into the bladder.

Upon the completion of the concentration reading the remainder of each specimen is added to its respective sides and the

<sup>2</sup>Krotoszyner, Martin and Stevens, William E. Jour. A. M. A., December 1, 1917, lxix, 1865-1871.

quantitative test completed in the usual way. The amount of phthalein in the bladder specimen is also determined.

This modification of the differential renal test with phenol-sulphonephthalein does not increase the time necessary for the patient to remain under observation. The two additional dilutions and readings on the colorimeter consume only a few minutes of time in each case.

It has been found of distinct value in the instances where marked leakage into the bladder has occurred.





## MALIGNANT DISEASE OF THE ADRENALS WITH REPORT OF A CASE<sup>1</sup>

H. G. FULLER

Preliminary to reporting a case of this kind it would not seem out of place to include a brief review of the literature. The adrenal glands, although described as early as 1563 by Eustachius, did not command interest of clinicians and pathologists until 1885 when Addison presented a paper on local effects of diseases of suprarenal capsules. Since then much has been learned as to the function and diseases of these glands. However there is yet a lack of clear understanding regarding clinical manifestations of the adrenal tissues and the results of surgical intervention. Clinical manifestations of malignant tumors of the suprarenal glands are by no means pathognomonic. This condition presents only "a pathology" as a majority reach the autopsy table with scarcely other than a provisional diagnosis.

Necropsy presents to the pathologist interesting difficult and diversified subjects for his study. In addition to benign tumors, which occur in the greatest variety, we find true carcinomas and sarcomas, the latter malignant growths, presenting many peculiarities in their growth and cellular pattern. Often it is difficult to tell whether we have a case of sarcoma, a cancer with perivascular growth, or a true perithelioma, etc. These various forms are usually classed as malignant hypernephroma.

As previously intimated, difficulties of preoperative diagnosis are very obvious, there being no clinical evidence to guide us. Most especially is this true wherever we have metastasis, as these are almost certain to dominate the clinical picture. The surgeon usually performs an exploratory operation holding in

<sup>1</sup>Read at the Annual Meeting of the American Association of Genito-Urinary Surgeons, Richmond, Virginia, May 2-3, 1921.

mind as a diagnosis, tumor of the abdomen, retro-peritoneal tumor, cholelithiasis, etc.

A real diagnostic certainty being quite the exception, even when a tumor is palpable it is apt to be confused with "perirenal abscess" growth of the kidney, gall-bladder, spleen, liver, etc. The commonest mistake is renal tumor from which it is extremely difficult to differentiate on account of the relation of the peritoneum to these two organs. Especially is this difficult if, as is so often the case, the tumor has invaded the kidney or become firmly attached to it.

To be sure ever present aids in the differential diagnosis are the urinalyses and pyelography. Attacks of pain especially of diagnostic importance are located in the hypochondrium and lumbar regions due to pressure on the first, second and third lumbar nerves and their branches.

Mayo Robson emphasizes shoulder pain in the symptomatology, thought to be due to irritation of a branch of the phrenic nerve. Others disagreeing, attribute this to metastases of the scapula. There seems to be no relation between Addison's disease and tumor of the gland.

Blackburn (1) reported in 1906 an interesting case of round cell sarcoma with tendency to alveolar arrangement. Here the symptoms were rather characteristic of adrenal tumor though insufficient for diagnosis in the absence of palpable tumor. The indefinite pain was present but it could not be located or elicited by abdominal palpation. The autopsy here revealed primary melanotic sarcoma of the right adrenal with most extensive metastases.

Of primary malignant tumors, those commonly recognized are sarcoma in various forms and carcinoma. Also malignant hypernephroma and, according to Prudden, certain vascular and hemorrhagic adenomas. The sarcoma is said to be much the more frequent.

Primary sarcoma must originate in the connective tissue or the epithelium of the gland. The latter is of mesodermic origin and histogenetically capable of forming a sarcoma. If carcinoma be derived from the adrenal it must originate from

epithelial elements while connective tissue forms its stroma, or from misplaced tissue of other blastodermic layers.

According to Carl Winkler(2) and Herxheimer, primary sarcomas of the suprarenal glands are very rare. Cases of spindle cell sarcoma, angio-sarcoma, round cell sarcoma, melano-sarcoma, lympho-sarcoma, etc., have been reported. Under the last title certain cases have been recorded which now would no longer be considered as sarcoma but would be regarded as tumors originating from the medullary portion of the gland and its specific cells, and would be treated as a tumor under the title of "Neuroblastoma sympathicum."

The first operations for extirpation of malignant tumors of the adrenals were done in 1885-1886 by Gussenbauer, Morris, Herff and Nicoladoni Wendal in 1904 collected twenty-four cases of tumor from the literature, all being treated surgically. The immediate mortality was 50 per cent and only six cases were followed by recovery lasting from six months to six years.

#### CASE REPORT

Male. Age forty-two. Occupation, builder. Family history negative. Previous history negative unless an accident last July, described as a landslide in which he was caught but to which he did not pay any attention at the time, might have had some bearing on subsequent events. Patient's last illness began September 1, 1920, with pain in the left side, located in the chest and extending around to the back. Regarded as being a pleurisy or some similar ailment for which chest was strapped. Patient then left the city, visiting a number of physicians during the next month without relief.

About October 1, an X-ray was made especially confined to the chest with a report showing enlargement of the aorta. It was suggested that a Wassermann be taken, which was negative. He was advised to go to bed for six weeks being put on potassium iodide. Pain increased in severity and on November 2, a large dose of morphine was given to control pain. Examination at this time showed dullness of left chest, up to fourth rib, absent breath sounds with fixed chest wall and tenderness over left kidney.

Sent to hospital and X-rayed the next day, the patient being carried directly from the ambulance to the X-ray room, the roentgenologist

being told the patient was thought to have empyema. First the patient was fluoroscoped which revealed that it was not a chest condition but an intra-abdominal trouble of some character. The next day he was X-rayed to learn of any kidney lesion. This showed clearly the presence of a large mass apparently below the diaphragm on the left side with what seemed to be a large stone or similar dense shadow near the center.

We were asked to see him at this juncture. Ureteral catheterization on November 4, showed negative kidney findings. Further X-ray examination with X-ray catheter in place showed same shadow but presumably not located in the kidney, in fact stereoscopic plates demonstrated a shadow showing posterior to the kidney. Dr. Merritt, roentgenologist, November 6, 1920, reported mass above left kidney elevating diaphragm and interfering materially with respiration of left lung. There is a calcified mass of considerable size, posterior to the kidney and on same level.

Examination by pneumoperitoneum, plate three on belly and plate four on right side, points definitely to the presence of a mass above the left kidney which does not separate from the left diaphragm and cannot be differentiated from the left kidney shadow apparently blending with it, regarded as being an abscess or new growth. The chest plate number two shows elevation of left diaphragm and decreased radiability of left lung but no evidence of disease of the lung.

All urinary examinations practically negative. Leucocyte count on admission 9000, lymphocytes 8 per cent, transitional 3 per cent, Polynuclear: Neutrophiles 89 per cent.

The one predominating symptom throughout his whole illness, especially after entering hospital, was severe unendurable pain and I might say especially referable to the posterior extending to the scapular.

The temperature up to this time was not over 100°. On November 8, we decided to operate, many diagnosticians having been given the opportunity to render a diagnosis. The best minds wavering between peri-nephritic abscess and new growth, presumably of the adrenal, the greatest leaning being toward the latter diagnosis.

A lumbar incision was made and a tumor mass was exposed, apparently springing from the upper pole of the kidney, extending upward and backward, displacing the diaphragm. The mass was distinctly above and non-adherent to the kidney structure presenting all typical and unmistakable physical characteristics of malignant growth of the left adrenal.

The large calcareous mass shown in the X-ray was located at the median and lower side of the mass. This was, with little difficulty, removed. The extent and adhesions on all sides of new growth together with its friability gave very definite evidence of the lack of wisdom of further operative procedure. So, after removing the calcareous area with portions of new growth for sections, the incision was closed, a large tube being inserted for drainage.

Maximum temperature up to November 16th was  $101.4^{\circ}$ , the 16th to the 22nd fluctuated between  $102^{\circ}$  and  $98.6^{\circ}$ . Patient steadily lost ground, dying on December 3.

We were fortunate in securing a post-mortem, a detailed report of which is included. I will read that referable to the pathological condition at issue, being confined to the large retro-peritoneal sac including the site of the left adrenal, there being found no evidence of metastasis anywhere.

Advantage of the size of the tube was made use of in after treatment for inserting a capsule of 100 mgm. of radium which was used three times. Patient steadily grew worse and I might say a few days before death developed a gastric fistula.

#### *Report of examination of tissue removed at operation*

Microscopic examination shows a fairly uniform mass of large cells with large nuclei, varying from round to oval. There are a number of very large cells with very large nuclei, some with multiple nuclei, and mitotic figures are seen.

Diagnosis: large round cell sarcoma.

A large bone-like mass taken from the region of the tumor is found to be completely soluble in hydrochloric acid and absolute alcohol. It is evidently a calcareous deposit.

#### *Report of post-mortem examination*

Body is that of a very emaciated white man.

External: There is definite though moderate jaundice, noticed in the sclerae. There are a number of small, irregular, pigmented moles on the abdominal wall.

An open incision (operative) is observed in the back, left side, just below the costal border, in the infrascapular region.

On incision of the skin, a very small amount of subcutaneous fat is found, and this is of a deep yellow color. The muscles are poorly developed.

The chest: The pleurae are free of adhesions at all points, there is no fluid in the pleural cavities. The diaphragmatic pleura is smooth on both sides of the chest.

The heart is of normal size. There is a small amount of straw colored fluid in the pericardial sac. (Heart not opened.)

There is no evidence of the thymus and no enlargement of the bronchial glands.

The omentum is nearly free of fat. It is not adherent to the wall of the abdomen or the viscera at any point.

The liver is not enlarged, but is somewhat pale in color. The gall-bladder contains bile, which is readily expressed through the ducts on pressure. No gall-stones are found.

The stomach is normal in appearance anteriorly. There is no evidence of a tumor mass on palpation and the pylorus is patent. Posteriorly the stomach is found to communicate with a large retroperitoneal sac, which will be described below. There is no thickening of the walls of the stomach at this point, but the tissues are quite readily broken down on manipulation.

No pathological condition of the intestines is observed.

The pancreas appears normal.

The spleen is of about normal size and appearance. There are a few adhesions in the neighborhood of the retroperitoneal sac, to be described, involving the anterior portion of the spleen.

The right kidney is of normal size and appearance. The capsule strips readily. The adrenal is normal.

The left kidney is of the same size and appearance as the right, except that an area of about 5 cm. in diameter on the anterior surface is denuded of capsule at a point in contact with the peritoneal sac referred to.

On section both kidneys have a somewhat grayish and granular appearance, and show a moderate degree of congestion.

Extending upward from the left kidney to the stomach and including the site of the adrenal, there is a large retroperitoneal sac, containing a red-brown grumous material, with a number of masses of firmer, friable, white and yellowish white substance. This sac is found to be in communication with the stomach and to be connected with the operated incision in the left back. On clearing out the sac, the wall is found to be smooth in the region of the peritoneum, but there is considerable destruction of tissue, including muscle, posteriorly.

No tissue which can be recognized grossly as adrenal tissue can be found.

There is no enlargement of the abdominal glands.

Bladder normal.

Microscopic examination of portion of tissue from retroperitoneal sac: There are areas of necrosis with large areas of fibrous and vascular network thickly interspersed with groups and masses of cells varying in size and shape. Many of these cells are suggestive of an epithelial type, others are of a round or spindle connective tissue type. Mitotic figures are seen and there are a number of very large cells with unusually large nuclei and some with multiple nuclei.

Anatomical diagnosis: Multiple pigmented moles. Small pericardial effusion. Retroperitoneal sarcoma (with degeneration), mixed cell type. Perforation of stomach. Mild degree of nephritis (not confirmed by microscopic examination).

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## DISCUSSION

DR. QUINBY: The extremely interesting case which Dr. Fuller has reported represents one type of tumor occurring in the adrenal gland. The case reported by Dr. MacKenzie illustrates the other type. In other words there are two varieties of tumor arising from the adrenal gland which are entirely different, not only in their histology but also in the clinical manifestations which they cause. The variety described by Dr. MacKenzie is known as the typical adrenal cortical tumor, and in as much as the adrenal in its developmental stages bears close relation to the sex gland, these tumors are most frequently found to carry with them clinical manifestations of abnormality in regard to the secondary sexual characteristics. Especially frequent is precocious puberty and so striking is this that such cases are found in the literature under the caption of "Infant Hercules." In the female sex they lead to precocious menstruation. While I was with Dr. Young in Baltimore, I had the opportunity to study a case occurring on the Gynecological Service of the Johns Hopkins Hospital, in which a tumor of the adrenal cortex occurring in a little negro girl of seven, had caused the early appearance of all changes associated with puberty. These adrenal cortical tumors are exceedingly interesting and have been very well described in an article by Glynn in the *Quarterly Journal of Medicine*, about six years ago.

The tumor described by Dr. Fuller is of quite a different type, and originates in the medulla of the adrenal gland. It is of embryonic type, taking origin in the primary adrenal blastema. I have seen one striking instance of this type of tumor which, interestingly enough, involved both adrenal glands. It occurred in a man just over fifty years of age who was referred to me for urological investigation. There was no abnormality in the urinary tract. His history was exceedingly interesting. Starting as a very vigorous individual who, while in college, rowed on



the crew and was active in athletics generally, he continued his physical activities, entered the lumber business in the West, made a fortune, and returned to the East to locate about ten or twelve miles from Boston. Here it had been his habit to walk daily to and from his office in the city. Suddenly, from being a very aggressive, physically active, individual, he changed, lost weight, and became also entirely different mentally. Life had no further interest for him; he became apathetic and apprehensive. On physical examination he had an abnormally low blood pressure, but other than this there was no outstanding feature of note. Looking back on the case, however, it was easy to see that he had in large measure assumed the condition seen in the laboratory in animals from whom both adrenal glands had been removed, and also the condition seen in Addison's disease. This condition has been described by the French writers as, "syndrome surrenale," and is characterized by extreme flaccidity of all the musculature of the body with loss of tonus. Subsequently this man developed a palpable tumor in each loin and shortly thereafter died. Autopsy showed bilateral tumors of each adrenal gland of the type which Dr. Fuller has shown.

Dr. FULLER: This case has been a tremendously interesting one to me and I enjoyed very much the discussion which was most interesting. I do not think there is anything to add to what has been said.



## A SURVEY OF THE TREATMENT OF ACUTE GONORRHEA IN THE MALE

A. REITH FRASER

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The treatment of gonorrhea has undergone so many changes within recent years that a survey of the methods at our disposal may be of interest. While gonorrhea occupies a lowly place as a killing disease, it unfortunately commands a very high position as a cause of disablement and ill-health. In the male it does not fall very far short of syphilis in this respect, but in the female it possibly supersedes it.

It is a cause of much regret that the gonorrhea patient has not yet learned that in no other disease is early diagnosis of greater importance. As we see him today the gonorrhea patient seldom presents himself earlier than the end of the first week of the urethral discharge and very often much later. The golden opportunity for successful abortive treatment is therefore lost, the disease is definitely established and the gonococcus has established one of the most difficult problems in medicine or surgery.

### TREATMENT MEASURES

Treatment measures may be discussed best under the following headings: (1) General treatment, (2) Medicinal treatment, (3) Local treatment, (4) Vaccine treatment, (5) Serum treatment, (6) Chemo-therapy, (7), Electrotherapy.

#### *General treatment*

General considerations may be dealt with under the headings: Hygiene of the patient; exercise; hydrotherapy; and diet.

1. *Hygiene of the patient.* This is a very important matter especially in the early stages, and one which is very often

overlooked. It is well to lay down a hard and fast régime for the patient, for one finds that, in the event of the disease running a chronic course, he will adhere to its principles later on.

First of all he should avoid all possibility of sexual excitement. This includes sexually-stimulating literature and bioscopes. Novels should be withheld, and if possible replaced by some heavy reading requiring thought and concentration. In this way the patient has some interest to hand, and he has less time to take an unhealthy interest in his condition and in his sexual apparatus. The evil habit of introspection will not develop so readily later on.

Good and sufficient warning should be given with regard to cleanliness, care of the hands and finger-nails, clothing, dressings, and utensils. He should use only his own personal towels, disinfect the common bath-tub after use, and personally destroy all soiled dressings. He should be warned about the danger of infecting his eyes, and the necessary precautions should be carefully outlined.

The patient should receive a smart purge at the outset, and the bowels should be well regulated throughout the attack. Constipation is conducive to the extension of the infection to the deep urethra, prostate, vesicles, and epididymes. Depletion of the pelvic veins on the other hand has a beneficial effect.

Complete rest on a hard bed is the ideal treatment at the onset of an attack, but few men will submit to this. The patient therefore should be instructed to avoid soft chairs, and generally move about as little as possible.

The penis should be carried in a small cotton bag suspended from the waist. At the bottom is placed a piece of cotton-wool soaked in some non-smelling antiseptic which serves to catch the discharge. Do not countenance the wearing of a plug of cotton-wool inside the preputial sac as an alternative, for this simply prevents the escape of pus, damming back the discharge in the urethra. Possibly the ideal method of carrying the penis is along the inguinal fold or upright on the abdomen, but these are not possible.

The testes should be supported in a well-fitting suspensory bandage. This may appear a simple matter, but in point of fact it is an exceedingly difficult one. A "well-fitting" suspensory bandage is not an easy thing to find. Most of the available types are badly designed. They certainly support the testes, but fail to consider the penis. Now the penis at this particular time is more important than the testes, and above all we must eliminate pressure exerted on the organ at the peno-scrotal junction, otherwise efficient drainage from the bulb cannot take place. Most bandages unfortunately press tightly on the penis at this point, and therefore must be condemned. The correct bandage raises the peno-scrotal angle as high as possible, immobilises the organ, and imparts pressure on, and support to, the testes. There is little doubt that the high incidence of inflammatory lesions, infiltration, and slow resolution, met with in the region immediately behind the peno-scrotal junction is the direct result of inefficient drainage.

2. *Exercise.* In the early stages all active exercise should be forbidden. Violent exercises, motor cycling, motoring, and even train riding, have all a tendency to foster extension of the infection. As the acute stage passes off, ordinary exercise should be increased so that in uncomplicated cases the patient should be living an ordinary quiet life by the tenth day. He will get well infinitely sooner if his frame of mind is healthy, his general outlook bright, and his surroundings congenial.

3. *Hydrotherapy.* From the very start of his disease the patient should be urged to drink as much bland fluid as possible. No limit should be set, but 25 glasses daily may be laid down as a minimum. This is the most valuable means of producing diuresis at our disposal. As a rule pain can be diminished by diluting the urine, and large quantities of lime-water may diminish its acidity. Barley water is also useful, and since the rationale of this procedure is apparent, it must be considered one of the most important therapeutic measures in dealing with acute gonorrhea. The value of this natural form of diuresis and vesico-urethral irrigation cannot be overstated.

4. *Diet.* Highly spiced food stuffs, chutneys, sauces, pickles, coffee and strong tea should be avoided. Apart from these only a few reservations need be made. Fish and milk foods should replace red meat in the early stages. In uncomplicated cases ordinary diet may be resumed by the tenth day.

Most important is the forbidding of alcohol in any form. If, however, the patient is a confirmed habitual drinker, this may be found to be impracticable. In such a case his daily ration should be considerably reduced and very much diluted with water.

### *Medicinal treatment*

Medicines include antiseptics, sedatives, aperients, and diuretics.

1. *Antiseptics.* It would be an easy matter to give a very long list of urinary antiseptics and so-called antigonococcal remedies. These include such drugs as hexamethylene tetramine, cystopurin, salol, salicylic acid, turpentine, resins and balsams and many patent drugs sold under various names, such as gonorrhol, salosantal, arhéol, gonosan, terogon, urocédrol, and many others. Their influence on the course of the disease is negative, and the balsam group, in addition, often caused gastric disturbances, renal upset and rashes. Many people, also, are intolerant of hexamethylene tetramine, and it is frequently responsible for increased vesical and urethral irritability. Although these remedies have been advocated for the treatment of gonorrhea, their use has now become obsolete, and they are never indicated.

2. *Sedatives.* These are required for the treatment of burning of the urethra, painful erection, hematuria and loss of sleep.

Burning of the urethra. This is controlled by reducing the acidity of the urine. This is best accomplished by the administration of large draughts of water, lime water, barley water, or milk and water. In addition a simple alkaline mixture may be prescribed, containing such drugs as sodium bicarbonate, potassium bicarbonate or citrate, or liquor potassi.

Painful erection. The most useful drugs are the bromides. Their action may be supplemented by cold applications to the

penis. Enemata containing antipyrin grains xx and tincture of opium minims xx, are also usefully given at night.

Hematuria. Morphine given subcutaneously combined with ergot given orally will control spasm with resulting styptic action.

Loss of sleep. Where narcotics are necessary, suppositories of opium, atropine or belladonna should be used. Their action in controlling the local conditions is an advantage.

3. *Aperients*. Regulation of the bowels is a most important part of treatment. It should therefore receive careful attention. Aperients are usually required, and by far the most suitable are the salts of magnesium.

4. *Diuretics*. Alkalies and alkaline diuretics are stated to be of particular value in the early stages. It is well known that the gonococcus cannot live in an alkaline fluid, and therefore all kinds of advantages have been claimed for the administration of any drug which will make the urine alkaline. The best diuretic effect is got by insisting on a large daily fluid intake, but simple alkaline mixtures and alkaline diuretic mixtures have their uses in supplementing the neutralizing and diuretic effect of this fluid intake. A large amount of bland urine excreted is much more valuable and important than a small excretion of a definitely alkaline urine. The former assists natural drainage, natural urethral irrigation and loosens and dissolves plugs of thick pus. The latter does neither and has merely an empirical and doubtful action on the human culture medium of the gonococcus. The diuretic action is therefore of the greater value.

#### *Local treatment*

Local treatment is carried out by urethral irrigation, urethro-vesical irrigation, urethral injection and urethral instillation. The most satisfactory method is undoubtedly urethro-vesical lavage. Urethral injection should only be carried out in cases where irrigation is impracticable, as for example, in the case of the out-patient who wishes to conceal his disease but cannot attend regularly for treatment. He will find it difficult to conceal an irrigating outfit and therefore is compelled to have re-

course to urethral injection. Urethral instillation throughout the whole course of the disease has its advocates, but it has the very serious disadvantage which, in the writer's opinion, is sufficient to damn the method from the start, of necessitating the passage of instruments into the inflamed urethra. Mc-Millan, however, has reported himself favorably impressed with results.

Possibly in no condition has local treatment been so unsuccessful as in gonorrhea. If innumerable remedies are advocated for the treatment of any pathologic condition, one is usually safe in concluding that none of them is satisfactory. This one finds is so in the case of gonorrhea. Practically every drug in the Pharmacopeia which held out the slimmest hope of achieving palliation or cure of the disease has been tried out. It has been clearly shown that the ideal medicament for dealing with gonococcal urethritis has yet to be found. The treatment of gonorrhea is still far from satisfactory, and is still very much in the experimental stage. If a case is seen before the discharge is fully established a rapid and complete cure is a matter of no very great difficulty. The success attending the "sealing in" abortive method of Ballenger is sufficient evidence of this circumstance. After the disease is established, and the gonococcus has entrenched itself beneath the epithelial lining and in the innumerable natural harbours of its human culture tube, the problem of its rapid and successful eradication has not yet been solved.

Something may be gained by discussing the following preparations, all of which have been stoutly advocated at various times: (1) Potassium permanganate, (2) zinc permanganate, (3) oxycyanide of mercury, (4) silver nitrate, (5) flavine compounds and other dyes, (6) organic silver compounds, (7) picric acid and its derivatives, (8) other mercurial salts, (9) other salts of zinc, and those of copper and alum.

1. *Potassium permanganate.* For all acute cases and in the vast majority of chronic cases potassium permanganate may be used with success. Indeed, at the present time it holds a position entirely its own. For some short time its claim to the pre-



mier position was challenged by acriflavine, but the contest was short-lived. In no type of case does acriflavine give the results obtained with potassium permanganate. Potassium permanganate is used in solutions of 1:12,000 to not more than 1:8,000. Lees adds 0.5 per cent sodium carbonate with good effect, chiefly by reason of its additional power to dissolve the exudate, and on account of its alkalinity to retard bacterial growth.

2. *Zinc permanganate*. In a strength of 1:10,000 to 1:6,000 zinc permanganate is a mild astringent antiseptic which may be alternated with potassium permanganate in the later stages with beneficial results. It counteracts the chemical changes produced on the urethral mucosa by the prolonged use of one particular chemical, without producing any deleterious effects of its own.

3. *Oxycyanide of mercury*. This drug in a strength of 1:8,000 to 1:4,000 assumes the premier place as an irrigating solution in cases of secondary infection. In these strengths it is non-irritating and is well tolerated by the urethral mucosa.

4. *Silver nitrate*. In some few chronic cases during the later stages, silver nitrate is a useful astringent in strengths of 1:20,000 to 1:10,000.

Of all the many preparations at our disposal, the writer has found these four solutions the most satisfactory. The rationale of their various actions is not understood. While one realizes that, in the present state of our knowledge, the volume of the irrigating fluid is more important than the nature of the antiseptic, one must confess that these preparations give better results than many other antiseptics which have no apparent disadvantage, even when used in the same volume and in relatively the same weak dilutions. It has been stated that potassium permanganate has some peculiar affinity for the gonococcus, and that oxycyanide of mercury has a similar affinity for secondary organisms. How far such a consideration enters into the rationale of their action is not clear, for neither can be used in the urethra in strengths which materially inconvenience the organisms concerned. Indeed, these solutions have no germicidal action

whatever in these strengths. Their beneficial action therefore cannot be attributed to any such quality. A chemotactic action must be considered, possibly to the organisms as well as to leucocytes. Potassium permanganate is negatively chemotactic in strong solution, but in weak solution it is positively chemotactic to leucocytes (Gabritchevsky). The value of weak solution may thus be partly explained.

Swartz and Davis have worked out a "factor" whereby the usefulness of any particular drug in the urethra may be gauged. This "factor" is obtained by dividing the concentration in which a drug will kill the gonococcus in twenty minutes by the concentration in which it can be used with safety in the urethra. The following table which they give is instructive:

DRUG	KILLS THE GONOCOCCUS AT	MAY BE USED AT	FACTOR
Silvol.....	1:400	1:4	100
Cargentos.....	1:800	1:4	200
Argyrol.....	1:800	1:6.6	121
Protargol.....	1:400	1:50	8
Potassium permanganate.....	1:2000	1:4000	0.5
Potassium mercuric iodide.....	1:40000	1:200	200
Chlorazine.....	1:3200	1:400	8

Were other things equal, and no drug had any obvious disadvantage such as a strong astringent action or a faculty for precipitating protein, one would conclude that, of the above series, the most useful drugs in the local treatment of gonorrhea would be cargentos and potassium mercuric iodide, while the one which has nothing to recommend it would certainly be potassium permanganate. Although what relation exists between this "factor" and the therapeutic value of the drug is not determined at present, it is the fact that, with the exception of potassium mercuric iodide of which the writer has no experience, the drug with the lowest, and indeed the only negative, "factor" has definitely proved its therapeutic superiority to any other member of the series.

The ideal solution for the local treatment of gonorrhoea should fulfil the following conditions:

1. Non-irritating to the tissues.
2. Penetrating to living tissues.
3. Toxic to the gonococcus.
4. Has not the property of precipitating albumen.
5. Is capable of dissolving pus and mucus.
6. Is capable of producing a free flow of serum from the inflamed surface.

Unfortunately we possess no such solution. Most are astringent, including potassium permanganate. None of the colloidal suspensions are penetrating to living tissues. Many are irritating to the tissues, and the majority have the property of precipitating protein in a very marked degree. The solutions we employ with greatest success, chiefly for lack of any better, possess only the following qualities:

1. Non-irritating to the tissues.
2. Do not possess the faculty of precipitating proteins.
3. Are capable of dissolving mucus.

These qualities we supplement by using large volumes of the solution, and depend on this factor to assist the tissues in their struggle with the gonococcus by establishing free drainage, and washing the canal free of pus, exudate and organisms. The obvious disadvantage of astringency we endeavour to eliminate by using an exceedingly dilute solution. Curiously enough what would appear to be the most important property of any successful drug, namely toxicity to the gonococcus, is not present. Clinical experience has proved that we have no drug toxic to the gonococcus in the urethra which is not hedged around with unsurmountable disadvantages and drawbacks. In this connection the remarks of Swartz and Davis on the possible adaptability of potassium mercuric iodide are suggestive. They say: "It is likely that a field of usefulness in the urethra is open to such a drug as potassium mercuric iodide as a therapeutic or prophylactic agent. Its great superiority as a germicide to the silver preparations and to other drugs in common use, together with its property of not precipitating proteins, should earn for it serious consideration." In our search for a drug for use in the urethra which will fulfil the conditions already indicated, such

suggestions should prove of value, even if any previous success has been attained by following entirely different lines of investigation.

In the present state of our knowledge we are compelled to use irrigating solutions from which we expect only mechanical effects. In order that they should not be irritating to the tissues, antiseptics have to be used in so weak a solution that, together with their lack of penetrating power and their short duration of contact with the organisms on the surface, there is no measurable germicidal action. Normal saline would be as efficient as many of the much-lauded "gonococcicides," but the presence of the antiseptic in the irrigating solution is useful in killing or inhibiting pathogenic organisms which may chance to gain access during storage or in the course of the most careful manipulation. This is the only valid reason for its use, with the exception of the unknown quotient already referred to. The volume of the fluid, then, is the more important factor. It is probable that more satisfactory results might be obtained by the use of an irrigating solution such as Dakin's fluid. A hypertonic saline solution containing free hypochlorous acid has much to recommend it. It is, moreover, non-toxic to the tissues, and is a rapid solvent of pus and mucus.

By irrigation, therefore, we hope to assist the tissues in their efforts to expel the gonococcus by securing free drainage, by allaying the local symptoms, and by preventing the further spread of the organism. Since we have no solution with gonococcidal properties, and since we cannot employ antiseptics in sufficient strength to seriously inconvenience the organism, the properties of the fluid should be those of loosening and removing the exudate without damaging the mucous membrane or lessening the elasticity of the tissues.

All known antiseptics tend to produce changes in the mucous membrane with long-continued use, and these changes are a hindrance to Nature's curative action. The action of these chemicals varies, however, and Nature may be less impeded if the antiseptic used is replaced by another at intervals during the course of treatment.

By greatly increasing the secretion of urine we secure a natural and important form of irrigation. This can be done by a large fluid intake already referred to.

Above all, we must avoid using any powerful irritating astringent solution which will simply increase the local inflammation, coagulate the surface exudate, and thereby hinder or prevent drainage, obstruct the escape of organisms, render them secure from any irrigating solution passing on the surface, and drive the gonococcus into deeper and still less accessible strongholds.

5. *Flavine compounds and other dyes.* Acriflavine and to a less degree proflavine have been stoutly advocated chiefly by Watson of Glasgow. It is claimed that these dyes are essentially toxic to the gonococcus in high dilution, non-irritating to the living tissues, and possess a high power of penetrating living tissues. Moreover they do not precipitate proteins, and one's impression is that they would carry a very high "factor" estimated by the Swartz-Davis method. In spite of these advantages proflavine was quickly dropped even by aniline dye advocates, and acriflavine has been exceedingly disappointing in the hands of all but a few workers. Other dyes such as methylene blue, trypan blue, and so on, have also given very poor results as irrigating fluids.

One is of opinion that acriflavine is a useful antiseptic at the stage when the urethral mucosa is intact, and the organism confined to the surface, that is to say within the first twenty-four hours of the appearance of the urethral discharge. After establishment of the disease acriflavine is capable of reducing the amount of purulent exudate in a remarkably short time. Thereafter, however, it has the faculty of promoting a mucinoid, quasi-purulent discharge which is persistent and extremely difficult to get rid of. It seems as if the dye had produced some serious chemical change in the urethral mucosa which prevents complete resolution and lays it open to the attacks of secondary organisms. The vitality of the mucosa seems very much impaired at the same time as the virulence of the gonococcus and other organisms is reduced. Thus a chronic sero-mucinous discharge is set up which is not comparable to a chemical urethritis proper,

which is more difficult to treat than a straight-forward gonorrhea, and which submits the patient to the risks of complications over a long period. Thus its toxicity to the gonococcus and its powers of penetrating living tissues (which, however, have not been established) are nullified by its chemical action on the mucosal lining. Possibly if acriflavine in a strength of 1:4,000 or less were used in an *alkaline* medium as a means of shaking the virulence of the gonococcus at intervals throughout the course of potassium permanganate irrigation, a field for its usefulness might be opened up. As a solution for prolonged and continued urethral irrigation, however, it is very definitely contraindicated.

6. *Organic silver compounds*: Silver preparations are indicated in the early abortive stage where they are lethal to the superficial gonococcus, where they produce an intense local hyperemia, and where they induce a profuse serous exudate which provides conditions for an active phagocytosis and also carries away dead and living bacteria. When the discharge is fully established their use is contraindicated. Most are colloidal emulsions and therefore have very feeble powers of penetration. In addition all are powerfully astringent and possess the faculty of precipitating proteins. In this way superficial exudate is coagulated, drainage is interfered with, and deeply-lying organisms are not embarrassed. In the late stages of chronic infection when astringent action is called for, silver nitrate in very weak solution is useful for advancing resolution by drying sodden mucosa, and is superior to any of the organic compounds.

Some of the best known silver preparations are albargin, 1 per cent, protargol, 1 per cent, argyrol, 5 per cent, melargin, 0.25 per cent, protosil, 1 per cent, silvol, 1 per cent, cargentos, 2 to 5 per cent, collosol argentum, undiluted, iodargol, undiluted, argentamin and many others. One outstanding disadvantage of the majority is the necessity of a freshly prepared solution, and the fact that distilled water is essential.

Koll of Chicago employs as a routine an ointment of the following formula: 1 per cent albargin, with a base of gelatin and tragacanth, to which, for its hygroscopic and antiseptic effect,

is added a small amount of glycerine. This ointment melts at body temperature. The preparation is supplied in glass tubes with conical nozzles. These are graduated so that the patient may readily gauge the amount of ointment required for each injection. The advantages claimed are its convenience and cleanliness, and a prolonged application of the medicament to the mucosal surface due to the clinging nature of the semi-solid consistence.

7. *Picric acid and its derivatives.* Picric acid in aqueous solution of 1 per cent strength or less is perhaps the equal of acriflavine in its powers of penetrating living tissues. It has the serious disadvantage of being irritative, and is badly borne by the urethral mucosa. It has a larger field of usefulness in the female where tissue modification can be closely watched and controlled.

Lees has found it useful as an alternative to potassium permanganate in the later stages of cases which "hang fire." The writer has found it clinically inferior to permanganate of zinc in these cases and therefore can see no indication for its use.

Lacombe has recorded a successful series which he treated with sulphurous anhydride gas. This he evolved in the urethra by injecting 5 cc. of a mixture containing four parts of picric acid, 6 grams in 1000 cc. of water, and one part of hyposulphite of soda, 17 grams in 1000 cc. of water. Both are heated to 37°C. This forms sulphurous anhydride gas and sodiumpicrate, and the pressure exerted by the gas is calculated to secure penetration into the gland follicles. Three injections are given in the twenty-four hours in the early stages, and the number is reduced as the case progresses.

8. *Other mercurial salts.* The perchloride and the biniodide of mercury are extremely irritating to the urethral mucosa even in strengths of 1:20,000. The indications for the use of the oxy-cyanide have already been referred to. So also have the potentialities of potassium mercuric iodide.

9. *Salts of zinc, copper, and alum.* With the exception of permanganate of zinc, the purely astringent salts such as the sulphocarbolate, and those of copper and alum, have no useful

indication in the local treatment of gonorrhea. They are in every way inferior to silver nitrate in the only stage of the disease where they could possibly be called upon.

### *Vaccine therapy*

There seems now very little reason to doubt the value of vaccines in the routine treatment of gonorrhea. Much work has been done, and for a long time there was a very great divergence of opinion as to the value of vaccines in acute gonorrhea. Many urologists dismissed them as a complete failure, others looked upon them as disappointing but remained hopeful, while others hailed them as an aid to treatment of the first importance. Their value and therapeutic effect was first appreciated in the complications of gonorrhea. Further work showed that their value is not confined to this type of case alone, and most workers will now admit that their value in acute gonorrhea is considerable. Vaccine therapy has not developed sufficiently to replace local and general measures, but as our knowledge increases this circumstance may yet come about.

At the present time vaccines fulfil two functions in the acute stages of gonorrhea:

1. To promote increased resistance on the part of the blood to the attacking organism.
2. To attack the organisms which have penetrated the urethral mucosa and are out of reach of the irrigating fluid.

Later on, when treatment is completed or advanced, vaccines fulfil yet another function:

3. To serve as a test of cure.

1. *To promote resistance.* Recovery from disease is due to the inherent faculty of the infected tissues of producing antibodies of which agglutinins, precipitins, bacteriolysins and complement-deviating substances are at present recognised. Whether each of these indicates an individual antibody or whether all of them are caused by a single antibody is not wholly determined. Nevertheless we know that the more complex the antigen, the more complex is the antibody and the more



specific is it likely to be. A single organism may present several antigens in its composition, each entirely distinct and unrelated. An adequate antibody response must therefore exhibit a similar complexity. Resistance on the part of the patient must depend on his power of producing plentiful antibodies and recovery from disease results from a victory of antibody over antigen.

The complexity of the antigen and the multiplicity of the antibodies indicate how difficult is the task of the patient in fulfilling the necessary requirements. It is therefore patent that any extraneous assistance in mobilizing antibodies will be welcomed by him. It is with a view to assisting his defensive apparatus in dealing with the antigen that we employ vaccine in the early stages of any bacterial disease. We seek as far as possible to assist him to produce specific antibodies, for these only are of value. Whether they are produced in response to a specific or non-specific artificial antigen is immaterial, so long as they are produced in sufficient amount.

Antibodies are cellulo-humoral in origin. When a vaccine is given during the course of a disease the tissues react locally, and produce antibodies by destroying and altering the substances of the dead bacteria injected. Antigens, with one or two doubtful exceptions, are protein molecules and are treated by the body tissues as proteins foreign to them. The reactions of the tissues, therefore, are reactions against foreign proteins, and are manifested in the blood stream by the presence of substances—greatly in excess of the amount of the original antigen—which cause recognizable changes in the foreign protein. A vaccine will thus aid the supply of antigen and therefore augment the production of antibodies. By repeating the dose of vaccine the local production of antibodies is renewed. In this way we can offer material assistance to the body tissues in their efforts to hinder the activities of the living attacking organism. Other things being equal, the larger the dose of vaccine the greater will be the response on the part of the body tissues. Toxic substances in the composition of the vaccine will determine the size of dose which one may safely employ. The protein or

antigenic part of the bacterium will therefore be greatly hindered by the toxic non-antigenic part. It is advisable if possible to wholly remove the toxic portion which is non-antigenic, and leave only the protein stroma antigenic portion of the bacterium in the antibody-producing vaccine.

One point is of importance when dealing with ordinary toxic vaccines. After injection a period occurs during which the power of resistance to the specific attacking organism on the part of the tissues is reduced. This negative phase lasts twenty-four to forty-eight hours, and is immediately followed by a positive phase. During this phase the patient's resistance is greatly increased, and the phase may last a considerable time. By regulating the dose and intervals of administration one positive phase may be superimposed upon a previous positive phase, and this one endeavors to do. The periods will vary considerably in different patients, but close study of their temperature charts will give very accurate indications.

By eliminating the toxin from the vaccine before administration the possibility of encountering a negative phase is removed.

2. *To attack the organisms deep in the urethral mucosa.* The gonococcus penetrates the epithelial lining of the urethra and passes into the subepithelial connective tissue very early in the course of its invasion. It is clear, then, that these organisms will not be seriously embarrassed by irrigating solutions passing along the urethral surface. By employing vaccines one hopes to attack them by means of antibodies circulating in the blood stream. Local conditions make this a matter of considerable difficulty and uncertainty, especially where so much depends on leucocytic activity. Such disadvantages as the localized nature of the disease which reduces the value of the bactericidal action of the blood stream, the non-specific nature of the endolysins of leucocytes, and the fact that living bacteria may be protected through phagocytosis against the action of humoral bactericidal substances, must be borne in mind. Nevertheless we have evidence of much local value of antibodies circulating in the blood stream, whether produced in response to a natural stimulus, to vaccines, or to chemo-therapeutic substances.

3. *As a test of cure.* The value of the provocative vaccine as a test of cure need not be discussed here. One would simply emphasize that no standard of cure in the male or female can be complete without it.

### *Types of vaccines*

Vaccines may be prepared from gonococci alone, or from gonococci plus the many secondary organisms usually found in the urethra during the later stages of an urethritis, such as staphylococci, or Gram positive and Gram negative diphtheroid bacilli. The former are known as simple vaccines, and the latter as mixed vaccines. Simple vaccines may be monovalent or polyvalent, depending on the number of strains of organism included in the emulsion.

The following types of vaccine are at our disposal: ordinary stock vaccine, sensitized vaccine, detoxicated vaccine, Bruchettini's vaccine and residual vaccine.

*Ordinary stock vaccine.* Workers who have employed stock vaccines advocate doses ranging from an initial 5 to 25 millions to a final dose of 100 to 250 millions of dead organisms. In this way a small local, focal and general reaction was induced. American workers as a whole advocated larger doses and consequently their results were more promising. It would seem that these vaccines are far too toxic to admit of very large doses being employed. In spite of this serious disadvantage sufficiently striking results were obtained to justify their use. Cases treated *ab initio* showed their good effect by the mildness of the attack and the decreased incidence of complications and relapses.

Cases vary considerably in their tolerance of stock vaccines, and reactions which follow their administration may be slight, moderate or severe. The control of the initial dose is of the utmost importance. As a rule 50 millions is a very safe initial dose. A mixed vaccine containing 50 millions gonococci and 150 millions staphylococci per cubic centimeter was prepared in the British Army and was known as *staphgon*. Nicolle and Blaizot had previously prepared *dmégon* in much the same way and the results from their vaccine had been consistently

good. Lumb published the first series of cases treated with *staphgon* and was successful in reducing the severity of the attack and the incidence of complications and relapses. Lees also has reported satisfactory results, and the writer's experience has been similar. Such stock vaccines are now available commercially and are in most cases extremely reliable.

A useful routine scale of dosage is the following:

<i>Days of treatment</i>		<i>Dose of vaccine in millions</i>
1.....	{ Gonococci Staphylococci	50 150
3.....	{ Gonococci Staphylococci	100 300
6.....	{ Gonococci Staphylococci	100 300
9....	{ Gonococci Staphylococci	150 450
12.....	{ Gonococci Staphylococci	150 450
15.....	{ Gonococci Staphylococci	300 900

General reaction is found to be negative after the initial dose and any local reaction is negligible. The latter, although quite definite, rarely causes any material inconvenience. The focal reaction is always apparent within twenty-four hours while the disease is active. There is usually a slight though definite increase of meatal discharge and an increased turbidity of the urine.

As time goes on and complications set in, a second and even a third course of vaccines should be given. Indeed it is a good rule to commence a second course if the discharge persists ten days after the first course has been completed.

By employing this routine as a supplement to correct local treatment it has been found that the florid stage disappears at the end of four or five days and the resolving stage begins. The discharge is no more than a bead of pus in the mornings and

most of the local discomfort clears up within this time. The attack therefore runs an extremely mild course and the liability to relapses and complications is appreciably diminished.

*Sensitized vaccines.* Besredka's sensitized vaccine is based on the fact that every cell when brought into contact with its specific antibody fixes it. The organism is used to abstract specific antibody from immune serum, and the combination of the bacterium and antibody, minus the serum, constitutes the sensitised vaccine. Cruveilhier was satisfied with the results secured with this vaccine. McDonagh was more successful with a gonococcal vaccine sensitized with immune human serum than with one sensitized with immune horse serum. The dosage he suggests is a daily increase thus: 100 million, 500 m., 1000 m., 2500 m., 5000 m., and repeat the 5000 million dose once a month for three months. These doses are administered subcutaneously or intravenously. The experience of most workers has been unsatisfactory with these vaccines.

*Detoxicated vaccines.* If the dosage of a vaccine is not curtailed by a high toxic content, the higher the dose the greater will be the antibody response. Commercial vaccines in large doses produce such marked toxicity that comparatively trivial doses only can be used. In doses which will produce a really adequate antibody response it is difficult to eliminate such reactions as fever, headache, sickness, diarrhea, and possibly several days of general malaise. In addition the negative phase is so long that any positive phase is seriously curtailed.

Since the toxins themselves possess no antigenic properties their presence in a vaccine is a drawback rather than an asset. Their complete removal would be a distinct advantage, and would permit of infinitely larger doses being employed. The antibody response would be proportionately greater, and the therapeutic effect would be consequently enhanced.

The preparation of such a vaccine is described by David Thomson (Lancet, London, April 16 and 23, 1921). Originally tried out by Lees in 1919, it was shown that therapeutic effects were obtained which were superior to those of stock polyvalent vaccines. Several workers have since got equally convincing

results. The writer's experience has been a happy one, but he is satisfied that for success with detoxicated vaccines, the correct strains of organism are absolutely essential. This is more imperative than in the case of commercial vaccines. Detoxicated vaccines composed of strains other than those causing the infection produce no therapeutic effect whatever. In Africa strains of organisms prevail which do not exist in Europe. Since these vaccines are made in Europe, African strains have not been incorporated, and in many cases (chiefly conditions other than gonorrhea) failure has been complete. The universal strains of the gonococcus, however, seem to be much more cosmopolitan, doubtless due to the migration of fighting men from all the battle-fronts to all the corners of the earth. European detoxicated gonococcal vaccines have given excellent results in Africa, possibly because the particular strains were available in Europe before the colonial troops returned to their homes.

The vaccine is best given in doses as set out below. One has found that the doses originally recommended can be considerably increased without reaction and with good therapeutic effect.

<i>Days of treatment</i>	<i>Dose of vaccine in millions</i>
1.....	3,000
5.....	4,000
9.....	6,000
13.....	9,000
17.....	12,000
21.....	14,000
25.....	17,000
29.....	20,000

One cannot do better than to quote Lees' original conclusions here. He says:

No other form of vaccine, sensitized or otherwise prepared, and no phylacogen, produces such rapid and great specific reactions unless used in toxic doses.

Even in doses of 10,000 millions no *negative phase* was produced. Detoxicated vaccine acts directly on the tissues and not by protein shock.

All vaccine-treated cases run a much milder course, and there is an absence of complications and less tendency to relapse, due to the fact

that the patient has circulating in his blood for several months after the symptoms have disappeared sufficient anti-substance to protect him for some considerable time.

When secondary organisms are found in the urethral discharge it is advisable to use, in addition to gonococcal vaccine, one made up from the micro-organisms found present.

Detoxicated vaccines should be of incalculable value in the complications of gonorrhoea in the female where local treatment is so limited.

*The Bruschettini vaccines.* Bruschettini of Genoa believes that the attenuation of bacteria by chemical or physical means destroys their antigenic power. He therefore proceeded to produce a sensitized vaccine in vivo. Large quantities of bacteria were introduced into the pleural cavity of an immunized rabbit. After a time the product obtained therefrom contains a large number of leucocytes impregnated with bacteria in a high degree of dissolution.

The pleural exudate thus obtained is purified of the toxins, which have been dissolved in the liquid portion, and rendered highly assimilative and rapidly and completely absorbable without reaction, general or local, even when inoculated in high doses. In the Bruschettini process it is the organism that acts. Sensitization and detoxication of the microbes occur in the manner in which we observe it in the process of natural recovery of infectious diseases. The atoxic properties of the vaccine prepared in this method appear to be demonstrated by the fact that quantities of vaccine several times stronger than normal can be inoculated without producing phenomena of a reactive nature (Veglia).

Promising results with these vaccines in acute gonorrhea and also in its complications have been reported by Chauvet, Lavatelli, Bauer, and others.

*Residual vaccines.* These have been introduced recently and are said to be non-toxic and carry a high therapeutic index.

To sum up, one must look upon vaccine therapy as having already more than justified its employment as a routine adjuvant to local and general treatment. Its place among routine treatment measures, already a prominent one, must, as our knowledge of vaccines increases, become still more predominant. The

best vaccine to employ is one which can be given in the largest doses without toxic effects: one which does not produce any violent local or general reaction: and one which most rapidly stimulates the production of the greatest amount of specific antibodies. At the present time, as far as the writer's experience is concerned, the vaccine which has most nearly fulfilled these requirements, and has given the most convincing results, is the detoxicated vaccine prepared by Thomson. Where secondary organisms are present in the urethra, a mixed detoxicated vaccine should be used.

### *Serum therapy*

The career of antigenococcal serum has not been a happy one. In acute gonorrhea only absolute failure has been reported. Some amount of success has attended the treatment of isolated cases of complications such as epididymitis, prostatitis and arthritis. In these cases Langeron and Bocca believe that septicemia may be prevented, that the treatment should be combined with other therapeutic measures and that it has no influence on the urethral condition.

Our ideas of the rationale of non-specific immunization are not sufficiently clear, nor are they sufficiently concise and well-defined, to admit of a discussion of their application to non-specific serum therapy. Many workers hold that investigation along these lines is retrogressive, but this is not so, for specific and collateral immunity, whether active or passive, have much in common. How much of the bacteriolytic process is performed by the serum itself, immune or normal, is undetermined. The bactericidal properties of immune serum are quite independent of, and have an entirely different mechanism from, its antitoxic properties. While there possibly exists a net work of multiple antigens in the make up of any given bacterium, many fractions of which are common to other bacteria, it is also probable that the antibody response is equally complex and heterogeneous. It is conceivable then, that the serum of an animal immunized against, say, the meningococcus may contain a collection of antibodies which are specific to the gonococcus, and produced in



greater amount than they would be in response to the antigenic effect of the gonococcus itself. The latter may be able to stimulate mass production of its dominant antibody, but can elicit only a weak response to the multiple subservient antigens which it carries in its make up. While the dominant antibody which decides specificity may be absent, the multiple subservient antibodies common to both gonococcus and, say, meningococcus—and it may be to many other bacteria—may be present in very large amount both actually and relatively.—Thus collateral immunity of high degree may be secured, while actual specific immunity is non-existent.

Efforts to treat gonorrhea and its complications with antipneumococcal and antimeningococcal sera, however, have been constantly unsuccessful. This, also, has been the experience with antigonococcal serum, and no analogy or conclusion, therefore, can be drawn.

#### *Chemo-therapy*

Many haphazard efforts have been made to deal with the acute urethritis of gonorrhea by injecting various chemo-therapeutic drugs into the general circulation. Mercury is known to have a certain faculty of stimulating the production of immune bodies in syphilis, and possibly for this reason was the drug most frequently tried. There was, however, no serious well-considered plan of procedure, and no theoretical hypothesis on which to build. The results therefore were uncertain and usually disappointing.

Succinamide of mercury in 0.5 gram doses given intramuscularly every fourth day was tried for no particular reason. In a great many cases it caused a great deal of pain, and the reason why in some cases it seemed to affect the discharge while in others it did not were not understood. Possibly an increased leucocytosis had something to do with it, but this is an uncertain factor on which to depend for therapeutic efficiency. Other salts used from time to time were the benzoate, phthalamide, bibromurate, and salicyl arsenate.

Intravenous therapy has been tried out experimentally chiefly in the complications of gonorrhea. Collargol and electargol have been reported on favorably, but results have been uncer-

tain. This has been the experience of Menzi and of Romeick, who recommend that this procedure should only be tried in robust cases which can be closely watched. Severe headache and albuminuria are apt to occur, even after 2 cc. doses of a 2 per cent solution. Bruck reports favourably on tryptaflavin in epididymitis. He employed a dose of 50 cc. of a 0.5 per cent solution. In gonococcal septicemia Bohland, Mergelsberg, and also Ahlswede have noted good results. Sanofflavin and argochrom (methylene blue and silver) gave uncertain results in the hands of Bruck, but more success attended the efforts of Ahlswede and Patschke with argoflavin. The effect on the acute urethral condition was uncertain, and the influence on the gonococci appeared negative. There was an excellent effect on gonococcal septicemia, arthritis, and tenosynovitis.

Much advance in the chemo-therapeutic treatment of gonorrhea we owe to the work of McDonagh who, working along the lines of his "Theory of Oxidation and Reduction" sought to establish its confirmation by evolving a therapeutic procedure from a chemo-therapeutic standpoint. His main object is to regulate oxidation over a large area, and for this purpose metals in colloidal form are employed. The obvious risk is that the metal itself may become oxidized, and this risk is a real one in such a disease as gonorrhea where the infection is purely local. In the early stages of the urethritis, then, it is a safer plan to employ a non-oxidizable metal such as palladium. Other valuable colloids are manganese, antimony, vanadium, sulphur (intramine), and ferromanganese-zinc (trimine).

Many schemes of treatment have been advocated both as regards the metal employed, and the size and frequency of the doses. So far the following plan seems to promise the best results, but each case must be treated on its merits and such signs as temperature, amount and nature of discharge, reaction of urine, and so on, fully considered. Colloidal palladium is given intramuscularly on the first day in a dose of 1 cc. At no subsequent date is palladium employed. It is merely used as an initial injection on account of the fact that it is a non-oxidizable metal. Four days later 0.5 cc. colloidal manganese is given intramuscularly, and repeated every four days until the discharge

disappears. The dose may be increased to 1 cc. if desired. Trimine may replace the colloidal manganese in doses of 0.5 to 1.5 cc., often with advantage. Should the case run a chronic course, however, intramine in doses of 2.5 to 5 cc. should gradually take the place of manganese or trimine.

The internal administration of sodium bicarbonate and potassium nitrate in large doses assists rather than retards the action of these chemo-therapeutic agents. These agents should not be considered as an alternative to correct local treatment. On the contrary, they are essentially auxiliaries, and should be employed in much the same spirit as vaccines.

Many disappointments have been met with, but occasional startling results have served to maintain one's interest. McDonagh believes that much of the failure is due to the intracellular life of the gonococcus, together with the fact that in the early stages the disease is a purely local one, and the call for *protective substances* is never very urgent. The first is probably the more important factor. Indeed the success obtained with detoxicated vaccines would seem to negative the latter.

In the complications of gonorrhea, however, the value of trimine and intramine is very striking. In no type of case is this more marked than in gonococcal arthritis. Their routine inclusion in the treatment of this condition is already well recognised, and their exclusion quite unjustifiable. In acute prostatitis, vesiculitis, epididymitis, and in gonococcal skin affections, trimine and intramine therapy should always be employed, not necessarily as an alternative, but certainly as an adjuvant, to other therapeutic procedures.

While recognizing that the application of The "Theory of Oxidation and Reduction" is essentially in the experimental stage, and in many quarters has been condemned in toto, one must confess that results sufficiently striking have been obtained to justify one in developing treatment measures along the lines indicated. By closely following the principles laid down by McDonagh, one finds that much of what is claimed for the success of treatment is realized. Should future research perfect chemo-therapeutic drugs, local treatment will assume only secondary importance, and in dealing with the disease entirely via the blood

stream a vast field will be opened up—in the male who finds it essential to conceal his treatment outfit, and in the female where the possibility of local treatment is so limited.

### *Electrotherapy*

The treatment of acute gonorrhea by electrolysis has been evolved by Russ, and in his hands it has given apparently excellent results. The rationale of his procedure depends on the fact that microorganisms suspended in saline solution in a U-tube fitted with electrodes will steadily migrate to the positive pole when the current is running. In addition to this migration, the organisms soon die after the current is turned on. With this data, then, it seemed reasonable to conclude that if the infected urethra were bathed in saline and a current passed through it, the organisms would be drawn to the surface and killed.

Treatment of gonorrhea by employing high-frequency currents has been advocated in America. The apparatus required is considerable, and, even on a small scale, expensive. A high-frequency of the Tesla or D'Arsonval type is essential, and portable coils are available.

A glass electrode is passed into the urethra and run off the Tesla side of a high-frequency transformer. The action of the current is to liberate from the small amount of air around the glass electrode ozone, which has high bactericidal properties. The violet light has also similar properties. As a rule, however the urethra is too sensitive to tolerate the vacuum tube.

An alternative procedure adopted by Snow and by Eberhart is to surround the penis with tin foil protected with wet gauze, and connect it to the D'Arsonval bi-polarity current (to all intents and purposes the diathermy current), the second electrode being in the rectum.

A third method is to apply a metal plate over the penis and a vacuum electrode in the rectum. In this way the sensitiveness of the urethra need not be considered. There is little doubt that the increased local leucocytosis established is beneficial, but possibly the important factor is the bactericidal action of the violet rays and of the ozone liberated.

I am indebted to Dr. A. G. B. Duncan and to Dr. David Lees for many useful suggestions in the preparation of this paper.

## GNOCOCCAL INFECTIONS OF THE KIDNEY

### REPORT OF A CASE WITH TRAUMATIC RUPTURE

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Notwithstanding the great frequency of gonorrheal infections of the lower urinary tract, similar infections of the upper urinary tract are conspicuously rare. Such an infection is not infrequently diagnosed upon presumptive evidence but these diagnoses are rarely demonstrable by methods of precision. The occurrence of a pyelitis during the course of an acute gonorrheal urethritis has often led to the diagnosis of a gonorrheal pyelitis. Many, if not most, of these cases if investigated bacteriologically would reveal a pyelitis from one of the more usual infecting organisms; namely, the tubercle bacillus, the colon bacillus or the staphylococcus. The literature seems to bear out this statement. Many such cases have been reported and this point emphasized. Illustrations of this are to be had in the cases presented by Marcuse (5, 6), Sellei and Unterberg (10). Marcuse (6) in 1903 cites a case in which a pyelitis developed during the course of an acute urethritis. In this case the tubercle bacillus was demonstrated in the urine and the diagnosis confirmed by guinea pig inoculation. Similarly Sellei and Unterberg (10) report three cases of acute gonorrheal urethritis complicated by a super-imposed pyelitis. In all of the three cases the colon bacillus was conclusively proven to be the exciting agent.

However, a gonorrheal infection may occur secondarily to a gonorrheal urethritis. Evidence is obtained from a review of the literature relating to the complications of gonorrhea, that infection of any organ or part of the body may occur. Even generalized infections may be produced in which many organs become affected simultaneously; the infection resulting from a

gonorrheal bacteremia. No body tissue is immune. It is this hematogenous route which is responsible for a major number of gonorrheal kidney infections.

#### ROUTES OF KIDNEY INFECTION

The possibility of infections reaching the kidney immediately suggests two likely methods; a hemic route and urinary route. During the course of most acute infectious disease, bacteria have been proven to enter the blood stream. This has been proven true repeatedly of the gonococcus. The all too frequent gonorrheal endocarditis and arthritis demonstrates not only that such does occur but also suggests in a very modest way its frequency.

In light of the work of Rosenow (20) and others, demonstrating with the streptococcus the infrequency with which this organism produces endocarditis except in the presence of actual trauma to the heart, it may be assumed that gonorrheal bacteremia occurs a great many times for every case of gonorrheal endocarditis encountered.

It has also been demonstrated repeatedly that bacteria may readily pass from the infected blood stream through the normal kidney without producing disease. If these bacteria are few in number or of the less virulent type, the healthy kidney will not become infected. If, however, the bacteria are abundant, of a virulent strain, or there exists a defect in the kidney itself, or one resulting in the stagnation of urine in the kidney pelvis, an infection will result. Probably these conditions are rarely fulfilled in the course of the usual case of gonorrhea. This factor explains, no doubt, the infrequency of gonorrheal kidney complications.

The urinary route, upon superficial consideration, suggests the more likely source of kidney infection. However, when the defensive mechanism of the urinary system is considered, this route must be of secondary importance, particularly in gonorrheal infections. The usual portal of entry for the gonococcus is the anterior urethra. By direction extension, in a certain number

of cases, the infection reaches the urinary bladder, producing a cystitis. This is more frequent in the female than in the male, due, no doubt, to the differences in anatomical conditions. The ureter however, is doubly protected against further extension. First, the sphincter action of the bladder wall on the ureter as it passes into the bladder, and second, by the continuous irrigation of its epithelium by the flow of urine. To explain those ascending infections which do occur, various mechanisms have been suggested. Sampson (21) has demonstrated a vesico-utero-ovario-renal circulation by which an infection may be carried directly to the kidney. This method although explained by a shunted circulation is essentially hemic in character.

Another suggested course is by direct extension along the mucosa of the ureter. The relative frequency of this mechanism is problematic. Certainly the edema produced by inflammation even in the vesical portion of the ureter would lead to a stagnation of the urine above and materially lessen the efficacy of the flushing of the ureteral mucosa. This mechanism is, no doubt, of considerable more importance in infections resulting from the motile bacilli than from the non-motile gonococcus.

Dissemination of the organism from the bladder to the kidney by means of the lymphatics has been frequently debated. Sakata (22) demonstrated by injection methods, a lymphatic connection between the bladder and the kidney. This connection is interrupted in a number of places presumably by the presence of lymph glands. Kumita (23) directed attention to the fact that these lymphatics connect with the perinephritic tissue and not the kidney itself. Stewart (24) by transplanting the ureters of dogs to their intestines, confirmed this fact; producing perinephritic inflammation without involvement of kidney parenchyma. However, kidney infection by the gonococcus may occur by this route, as suggested by the case presented by Stanton (15) in which the entire kidney was involved, with the formation of multiple subcortical abscesses. However, the weight of evidence is opposed to a frequent infection of the kidney in this manner.

## COLLECTED CASES FROM LITERATURE

A survey of the literature confirms the statement made earlier in this paper that gonorrheal infections of the kidney are rare. Only 24 cases of proven gonorrheal infections of the kidney have been found. A large majority of the literature dealing with this subject is based upon subjective evidence. A variety of clinical signs which are in themselves insufficient, are presented as evidence upon which to base a diagnosis of a gonorrheal infection of the upper urinary tract. The demonstration of the gonococcus by staining or cultural methods in material obtained directly from the kidney pelvis or kidney substance is the only satisfactory method of definitely diagnosing gonorrhea of the upper urinary system. No consideration has been given to those reported cases in which a diagnosis was not based upon this demonstration. No mention is made in the accompanying tabulation of such cases since they tend towards confusion rather than elucidation of this subject.

It may be assumed from the fact that a small number of authentic case reports of this condition were found under titles conveying but indefinite suggestion of the nature of the report that other similar reports have escaped attention. However, a careful search of the literature revealed but 24 preceding cases in which the gonococcus was definitely proven to be an infecting organism. The case presented by the writer makes the twenty-fifth case. Of these 25 cases, only 15 were proven to be of pure gonococcal origin. Sixteen of the reported cases occurred in males. This is no doubt explained by the fact that gonorrhea is more prevalent in the male than in the female. The age at which this infection occurs is not significant except in the fact that it occurs at about the same age that the majority of primary gonorrheal infections are seen. The earliest symptom referable to gonorrheal infection of the kidney occurred in the case reported by Marcuse which was only ten days following the onset of the acute urethritis. The most remote was that reported by Stanton in which the primary infection had occurred nine years previously. The fact that many of these cases occurred at a



period of months or years after the initial infection is significant of the fact that the gonococcus may remain dormant in the body for a long period of time and later demonstrate itself in lesions distant to the original focus of infection. Both kidneys were infected in but 6 cases; the right being infected alone in 12 cases and left alone in 7 cases. The series is too small to draw conclusions from these figures. Infection of the pelvis of the kidney only, was demonstrated in 12 cases, and the kidney, together with the pelvis was infected in 9 cases. A general bacteremia from the gonococcus was proven in 3 cases by a demonstration at autopsy of one or more visceral foci elsewhere in the body. The most frequently associated infection was that due to the colon bacillus.

#### AUTHOR'S CASE

In presenting the following case, I am indebted to Dr. H. E. Ransom and Dr. C. F. Smith, under whose care this patient was admitted to the Hospital.

This case is unique in combining the infrequent condition of kidney fracture with that very rare condition of pure gonococcal kidney infection. The case is further of interest from a standpoint of diagnosis. The clinical picture was quite puzzling at the time of admission and the urgency of immediate surgical intervention so obvious that adequate time was not afforded for an exhaustive study of the case.

W. S., male, negro, laborer, single, age twenty-two; admitted to the Iowa Methodist Hospital, September 20, 1920.

*Complaint.* Violent pain in abdomen chiefly in right side.

*Family history.* Negative.

*Personal history.* The general health of the patient has always been good. He had pneumonia twice at age of ten years. Denies other diseases. Denies syphilis.

*Present illness.* In May, 1920, the patient contracted gonorrhea; was never incapacitated from work. Received only medication by mouth. No injections or instrumentation. The urethral soreness together with the discharge disappeared on the fourth day of treatment. Has had no symptoms referable to the genito-urinary system prior to

ESSAYIST	DATE	SEX	AGE	INTERVAL AFTER INFECTION	WHICH KIDNEY	PROVEN SEPTICEMIA*	PYELITIS
1. Gerster (1).....	1897	M	10	3 weeks	Both	No	No
2. Asahara (2).....	1898	F	16		Both	Yes	
3. Asahara (2).....	1898	M	40		L	Yes	
4. Lewis (3).....	1900	M	34	Denied gonorrhea	R	No	No
5. Casper (4).....	1901		25	7 months	R	No	
6. Casper (4).....	1901		23	6 years	R	No	
7. Marcuse (5).....	1902	M	25	2 years and 3 months	R	No	Yes
8. Marcuse (6).....	1902	M	22	10 days	R	No	Yes
9. Wynn (7).....	1905	M	19		R	Yes	
10. Dodge (8).....	1905	F		3 weeks	L	No	Yes
11. Lewis (9).....	1906	M	24	6 years	L	No	Yes
12. Sellei and Unterberg (10)...	1907	M		10 months	R	No	Yes
13. Sellei and Unterberg (10)...	1907	M		3 months	R	No	Yes
14. Tedenat (11).....	1907	M	24	1 year	L	No	Yes
15. Weisswange (12).....	1908	F	34	7 years	R	No	No
16. Hagner (13).....	1910	M	35	10 years and 6 weeks	R	No	Yes
17. Nixon (14).....	1911	F	22		L	No	No
18. Nixon (14).....	1911	F	48		L	No	Yes
19. Stanton (15).....	1913	F	40	9 years	Both	No	Yes
20. Hoover (16).....	1915	M	41	6 years	R	No	Yes
21. Hoover (16).....	1915	M	35	5 years	Both	No	Yes
22. Boyd (17).....	1915	M	31	3 months	Both	No	
23. Buerger (18)†.....	1918	M	30	1 year	L	No	Yes
24. Bastos (19).....	1909				Both	No	
25. Simmons.....	1921	M	22	6 months	R	No	Yes

\* Proven by finding multiple gonococcal foci in body.

† Second case; gonococcal infection of kidney not proven.

PYELO-NEPHROSIS	PYELO-NEPHRITIS	BLADDER INFECTION	OUTCOME	CULTURE	STAINED SMEARS	CHARACTER OF INFECTIONS
100 cc.	Yes	Yes	Recovery	Yes	Yes	Gonococcus and Staph. albus
	Yes		Autopsy	No	Pus and tissue	Pure gonococcus
	Yes		Autopsy	No	Yes	Gonococcus, bacilli and other cocci
	Yes	No	Recovery	Yes	Yes	Gonococcus and tubercle bacilli
		Yes	Recovery	No	Yes	Gonococcus
		Yes	Recovery	No	Yes	Gonococcus
	No		Recovery	No	Yes	Pure gonococcus
	No	Yes	Recovery	No	Yes	Pure gonococcus
	Yes		Autopsy	Yes	Yes	Gonococcus, bacilli and Staphylococcus
	No	Yes	Recovery	No	Yes	Pure gonococcus
	No	Yes	Recovery	No	Yes	Pure gonococcus
	No	Yes	Recovery	Yes	Yes	Pure gonococcus
	No	Yes	Recovery	Yes	Yes	Gonococcus and colon bacilli
	Yes	Yes	Recovery after operation	Yes	Yes	Gonococcus, colon bacilli and Staphylococcus
	Yes	Yes	Recovery after operation	No	Yes	Gonococcus (possibly others)
Normal X-ray	No	No	Recovery	Yes	Yes	Pure gonococcus
	Yes	No	Recovery after operation	Yes	Yes	Gonococcus (later tubercle)
Contracted pelvis	Yes	Never vesical symptoms	Recovery after operation	No	Yes	Gonococcus and typhoid bacilli
Slight	No	Yes	Autopsy	No	Yes	Gonococcus
6 cc.	No	Yes	Recovery	Yes	Yes	Gonococcus, pure
4 cc.	No	Yes	Recovery	Yes	Yes	Gonococcus and colon bacilli
	No	Yes	Recovery	No	Yes	Pure gonococcus
	No	Yes	Recovery	Yes	Yes	Pure gonococcus
				Yes	Yes	Pure gonococcus
200 cc.	No	No	Recovery	Yes	Yes	Pure gonococcus

the day before admission. Denies symptoms of cystitis or pyelitis during this interval.

On the day prior to admission to hospital the patient was struck in the abdomen with a large lump of coal. The blow was of sufficient force to cause the patient to fall. At this time he suffered a severe pain in the upper right quadrant of the abdomen. This pain moderated after a "few minutes" and the patient continued to work. The pain started again and soon became so severe he was forced to stop work and go to bed. At this time there was nausea, but no vomiting. The pain was of a dull, aching character, beginning in the right side and gradually extending to the right flank and inguinal region. A physician was not called until the following morning. The patient when first seen complained only of pain.

*Physical examination.* Upon admission to the hospital the patient appears acutely ill. The features are pinched. The patient is apparently in great pain. The body is well developed. The head, neck and lungs are negative. The heart action is good. The rate is 78. The abdomen is not distended. The muscles of the right abdominal wall are rigid and the abdomen extremely tender. The left abdominal wall is less rigid, but too rigid for deep palpation. The point of most tenderness was the upper right quadrant about the mammary line. There was no urethral discharge. The temperature was 101.4°F.; respirations 24; pulse 78; white blood cells 39,400. Urine specimen could not be obtained.

*Operation.* Right rectus incision was made for exploration of the abdomen. The appendix was large and was removed. Gall bladder normal. Stomach normal. Omentum and peritoneum in upper right quadrant congested. Tumor mass felt in region of right kidney. Right kidney exposed by lumbar incision. On stripping away kidney fat a fracture in the markedly thinned kidney parenchyma could be readily palpated through the unbroken capsule. The fracture was transverse to the long axis of the kidney and about 9 cm. in length. It had spread apart until the index finger could be placed in the opening by depressing the capsule. The capsule was opened and about 8 ounces of a thin blood stained, purulent fluid expressed. A portion of this fluid was obtained for laboratory examination. The kidney substance was thinned to about 1 cm. in thickness. The kidney pelvis was explored through this opening for stones. None were found. Two rubber drainage tubes were placed in the opening into the kidney and the wound closed around them.

*Post operative history.* The temperature fell to normal on the eighth day and the drainage was removed. The temperature remained normal until the twenty-eighth day when the patient was discharged from the hospital.

*Laboratory report.* From direct smears without sedimentation, large numbers of intra and extra-cellular Gram negative, biscuit-shaped diplococci were demonstrated. Cultures were made upon the usual media and also upon 1 per cent glucose-acetic fluid agar. No growth was obtained upon any media except the latter. This growth was a pure culture of the gonococcus. The appendix was normal.

From the standpoint of diagnosis, this patient presented a most interesting condition. The extreme condition of the patient, together with his pronounced abdominal rigidity and tenderness precluded satisfactory diagnosis. The complexity of this clinical picture illustrates the unreliableness of the usual textbook diagnosis of rupture of the kidney.

In this case it is impossible to determine how long this gonorrheal kidney condition had existed, or what the outcome might have been had the trauma not intervened. It is certain, however, that the infection was not of very recent origin, since the marked hydronephrosis had caused an atrophic thinning of the kidney substance to a marked degree. The course of the infection must have been mild since careful inquiry elicited no history which would even suggest kidney infection prior to the accident.

The hemic origin of this infection is very strongly suggested by the completely negative history concerning cystic discomfort or disease prior to his admission into the hospital.

#### CONCLUSIONS

1. Gonorrheal infections of the kidney are of rare occurrence, only 24 previous cases having been found in literature.
2. Gonorrheal infections associated with infections from other organisms are relatively frequent; 10 cases having been reported.
3. Hematogenous infections seem to be more common than ascending infections.

4. The demonstration of the gonococcus either by cultural or staining methods in the kidney tissue or the excretions from the kidney is the only sufficient criterion for diagnosis.

5. Gonorrheal pyelitis may exist without symptoms of sufficient gravity to suggest its presence.

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## CHRONIC INFECTIONS OF THE MALE URETHRA AND ITS ADNEXA

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In a previous article, in speaking of these post-gonorrheal infections, I stated that this class of case was proving most instructive and interesting, and, while an occasional case occurs which tends to test the patience and ingenuity of the surgeon, the results obtained from appropriate and systematic treatment, in the very large majority, will repay him for the trouble taken. The presentation of this series of clinically cured cases of this most common of all the significant and potentially infectious genito-urinary diseases, requires no further explanation.

It is not intended to imply that these one hundred cases represent 100 per cent cures by the methods of treatment herein described. Many patients presenting themselves, disappeared before a cure could possibly be effected. No attempt at treatment was made in another considerable number of patients presenting themselves, when it was found that circumstances prevented them undertaking a prolonged and regular course of treatment, or when it became evident, at the first or second interview, that the patient was not prepared to place the management of his case fully in my hands for a considerable period of time.

No attempt is made in the following remarks to describe any new symptoms or laboratory findings in this well known and very prevalent condition. Nor is it intended to describe any new, or advocate any special, methods in the treatment. In investigating these cases, my only motive at the beginning, was to learn, with some degree of accuracy, the length of time and the amount of regular, systematic and judicious treatment required to rid such cases of all symptoms of their infection.

Each of these cases conformed to the following clinical conditions before being discharged as cured:

1. Absence of urethral discharges.
2. Absence of any urinary disturbance.
3. The urine macroscopically free of cloudiness, filaments, shreds, or flakes.
4. The urine free of microscopic pus, etc.
5. The whole urethra free from infiltrations, etc., on inspection.
6. The prostate and seminal vesicles normal on palpation.
7. Secretions of prostate and seminal vesicles showing not more than three pus-cells to the high-power field on two films, made three to eight weeks after treatment had been discontinued.

The complement fixation test for gonorrhea was not relied on as a criterion of cure, and was done in only ten cases. Three of these had been given vaccines, which probably accounted for the positive results. In four, who still showed filaments in the urine, a negative complement fixation was found, but the patients continued treatment until these fine filaments in the urine had disappeared.

The precipitin reaction of Robinson and Meader was not made in any of these cases.

*Age* (table 1). The average age of these patients was 27.23 years. Seventy-two were between twenty and thirty years; twelve were between thirty and forty years; nine were between forty and fifty years; four were fifty years, and over; while three were twenty years, or less.

*Social state* (table 1). The fact that, approximately, 33 per cent of the unmarried men in this series were engaged to be married, is significant, and would tend to show that at least a fair proportion of the unmarried male population would favor legislation making a thorough physical examination compulsory before a marriage license is granted. This considerable percentage should also be encouraging from the point of view of the sex-hygiene educationalist.

*Time elapsed since last acute urethral infection* (table 1). The patient, giving a history of his last acute infection twenty years

ago (the longest period in this series), had a filiform stricture of the membranous urethra, with an accompanying infection of the prostate and seminal vesicles. The patient with the most recent acute infection (two and a half months), had his first acute infection four years before, and his last acute attack was most probably a recurrence of his original infection. The rather long average time of thirty-six and a half months, or, approximately, three years since the last acute urethral infection, shows the persistence of the subjective symptoms of these infections. The majority of these patients had received prolonged, if rather irregular, treatment from general practitioners. Many had been treated,

TABLE 1

Age.....	Oldest: 54 years	Youngest: 18 years	Average: 27.23 years
Social state.....	Married: 23	Unmarried: 77	Engaged to be married: 26
Time elapsed since last acute urethral infection.....	Longest: 20 years	Shortest: 2.5 months	Average: 36.5 months
Duration of treatment, in weeks.....	Longest: 48.8 weeks.	Shortest: 5 weeks	Average: 8.5 weeks
Time elapsed since treat- ment completed.....	Longest: 47 months	Shortest: 3.5 months	Average: 10.72 months

for short periods, by many different regular physicians, by advertising specialists, besides treating themselves with every patent medicine they could become acquainted with. One patient had, in two years, spent an average of over three hundred dollars a year on medicines alone, in search of a cure. Approximately 76 per cent of these patients were referred to me by confreres, and, in a considerable number of cases, the progress of the patient was followed by his physician to the completion of treatment.

*Duration of treatment* (table 1). In estimating the duration of treatment, two office treatments represent, roughly, one week. This means that the patient in this series, who was cured in the shortest period, received ten office treatments, while the patient

requiring the longest period to cure, received, approximately, ninety-seven treatments. The average number of treatments for the whole series was seventeen.

It was a surprise to me, in first investigating these one hundred cases, to find that so many treatments, and such long periods of time, had been necessary to clear up these conditions. In looking up the literature, I could find no reference to the length of time, or approximate number of treatments, required to clear up these infections, nor anyone's actual experience with any considerable number of cases.

An endeavor was made, in each case of this series, to have the patient report, in person, in two months after all treatment had been discontinued, for a final investigation of his condition, or, where such was not possible, to report this condition by letter. Eighty-seven patients were seen personally or reported by letter, in from two to sixteen months after their last treatment, and none had suffered any recurrence. Thirteen were not heard from after treatment was completed.

*Urethral discharges* (table 2). In sixty-six patients, urethral discharge, discernible by the patient in the morning only, was the principal complaint. In thirty-four no urethral discharge was noticed by the patient, these patients coming for consultation for cloudiness or shreds in the urine, slight disturbances of urination, difficulty, or urgency of urination, urethral discharges after stool, old epididymitis, arthritis, lumbago, etc.

Gonococci were demonstrated in films of the urethral discharge in only four cases before treatment was begun. In eighteen of these sixty-six cases with urethral discharge, typical intracellular gonococci were demonstrated in films of the discharges some time after treatment had begun. In one case, gonococci were found, for the first time, after the twentieth treatment.

*Secretions of the prostate and seminal vesicles* (table 2). On microscopic examination of these secretions from twenty patients, pus cells were found in sufficient numbers to be classified as abundant, and in only three of these were gonococci demonstrated on examination previous to beginning treatment. In eighty patients, only sufficient pus cells were found to be classified as a few,

or a very few, on the first examination of these secretions. In 44 per cent of this series of cases, typical intracellular gonococci were found microscopically in these secretions for the first time at varying periods after regular treatment had been instituted. This means that at least twenty-four cases in which the secretions from the adnexa, showing only a few pus-cells and no gonococci

TABLE 2

Urethral discharge.....	Discharge present before beginning treatment: 66	Gonococci demonstrated before treatment begun: 4	Gonococci demonstrated after treatment begun: 18
Secretions of the prostate and seminal vesicles.....	Showing only few pus-cells, B. coli, etc., before treatment (no gonococci): 89	Showing abundant pus before treatment (gonococci in 3): 20	Gonococci demonstrated after treatment begun: 44
Complications...	Epididymitis present before treatment begun: 24	Epididymitis developing during treatment: 4	Urethral strictures: 8. Arthritis, Tenosynovitis, etc.: 16
Concurrent conditions.....	Narrow meatus (17-18° F. calibre): 27	Sexual neurasthenia: 12	Syphilis (positive blood Wassermann): 6
Operations done as part of treatment....	Perineal section for drainage of prostate and seminal vesicles: 4. Intra-prostatic injection needling): 2	Urethrotomies, external and internal: 4	Epididymotomy: 3. Orchidectomy for abscess: 1. Vas puncture (Belfield): 3

before treatment, showed typical gonococci at some time during the course of their treatment.

It cannot be definitely concluded that gonococci were not present in the secretions in every case, because they were not demonstrated in films made before treatment was begun. It is, however, justifiable to conclude that, in a not inconsiderable number of cases, these organisms were dislodged from their hiding places in the tissues, by the manipulations of treatment.

The histories of twenty-two of this series of one hundred cases state that, at some time previous to coming under my observation, a diagnosis of non-specific urethritis had been made by reputable physicians, in many cases, after repeated microscopic examinations of their secretions, and, in a few cases, the patients told they were quite safe to marry. Nine of these twenty-two cases, or 40 per cent, are included in those above described as showing gonococci in secretions from either the urethra or the prostate and seminal vesicles after regular treatment had been carried on for varying periods of time.

The frequency with which gonococci were demonstrated during the treatment of these cases, disproves entirely the statement of Keyes, quoted by Barringer in Cabot's Urology, in which he states that he believes the gonococcus does not persist in the male urethra for more than three years, while, in at least ninety per cent of cases, it disappears, with, or without, treatment, within a year. Stokes comes much nearer the truth when, in discussing gonorrhea, he states that, in the sociology of the disease, "gleet" is its most dangerous stage.

*Complications* (table 2). Twenty-four of these patients, on coming under observation, showed signs and gave histories of a previous epididymitis. Four developed a more or less acute epididymitis during the course of treatment. One of these had a meatus which admitted a no. 17 French bougie, and was not incised, at the earnest request of the patient; one developed after the passage of a soft rubber catheter, and, in two cases, no cause could be given except that both were performing heavy work, one as a laborer, and one as a telephone lineman.

Strictures of the urethra, of varying calibres, occurred in eight patients, four of whom required operative treatment, two external and two internal, urethrotomies. In one case of external urethrotomy, a suprapubic cystotomy became necessary for sudden, severe hemorrhage, brought on by an in-dwelling catheter.

Rheumatic symptoms occurred in sixteen patients, in eleven of whom some operative interference became necessary. Epididymotomy was done in two cases, with macroscopic demonstration of pus in both. Belfield's injection of the vas deferens was

done in three cases; in two, both vasa were injected, and only one side, in one case. In one of the cases having both vasa injected, no change in the arthritic symptoms took place; in the other case, employing exactly the same technique, very marked improvement was seen. Within ten days, all pain, and most of the swelling about the joint, had disappeared. The improvement remained for four months, when the patient was discharged from further treatment.

Four of these eleven cases were subjected to perineal section for drainage of the prostate and seminal vesicles. One of these had a recto-prostatic fistula, with gonococci demonstrable in the rectal discharge. Three of these four cases showed marked improvement in their systemic, as well as their urethral, symptoms. The fourth case, showing only slight improvement in his systemic infection, was the patient with the recto-prostatic fistula. The fistula healed, and his urethral symptoms cleared up after four weeks. This patient developed an epididymitis after operation, which may have accounted for the slight improvement in his arthritic symptoms.

Paracentesis of the prostate (needling through the perineum) was done in two of the arthritic cases, a small quantity of macroscopic pus being demonstrated in one; in both, the prostate was infiltrated with 30 cc. of Cano's phenol serum. In both these cases, improvement in both the arthritic and urethral symptoms took place. In one, the improvement appeared quite as marked as in any of those subjected to perineal drainage of the prostate and seminal vesicles.

Orchidectomy was done in one case, after aspirating pus containing gonococci, from a fluctuating testicle.

*Concurrent conditions.* Meatotomy was done on twenty-seven patients of this series, the indication for this simple procedure being a marked disproportion between the calibre of the meatus and that of the anterior urethra. This disproportion was said to exist when the meatus would not easily admit a no. 18 French bougie, with an urethra of average calibre. Besides facilitating natural drainage for urethral discharges, this operation greatly facilitates inspection, and treatment by sounds, topical applications, etc.

It would seem more than a coincidence that twenty of the twenty-seven patients requiring meatotomy, were among those with a history of an epididymitis previous to coming under observation.

The symptoms of sexual neurasthenia, occurring in twelve patients, were very mild in the large majority, and totally disappeared during the course of treatment in all but two, both of whom failed to report for re-examination after treatment was completed, and have not since been heard from.

Syphilis occurred in only six patients, four of whom had previously received very thorough treatment. Only two showed a positive Wassermann during their routine examination, previous to beginning treatment for their urethral infection.

*Treatment.* Only well-tried and rational methods were made use of in this series. The treatment, generally speaking, is essentially local, and every case must be dealt with individually, after the foci of infection have been located, and the causative organisms, so far as possible, identified. No standardized method of treatment can be followed in any urethral condition, because, as is well known, a procedure which would be used to great advantage in one case, would do harm in another. This is well exemplified in the use of silver nitrate solutions for instillations, irrigations or topical applications. These, while well borne and of benefit to the majority of cases, if used in proper strengths, appear to be distinctly harmful to others.

Medicines by mouth were used only when thought to be definitely indicated. No drugs were used by hypodermic, intramuscular, or intravenous injection. Vaccines, mostly stock, and, in a few cases, autogenous, were used in approximately 60 percent of these cases. No undoubted and direct benefit could be said to have been obtained except in those cases showing gonococci in their secretions, when pure gonococcus vaccines, in maximum dosage, appeared to hasten the disappearance of these organisms.

Bougies of metal and elastic web composition were used as indicated for dilatation of the urethra, and stimulation of its mucosa, always followed by an antiseptic. Dilators of the Kollman type were used in a few of the earlier cases, but were totally discarded



because it was decided that gentleness could not be assured as well as could be done by other means.

The following antiseptic drugs were used as irrigations, instillations, topical applications, etc., as seemed indicated: Oxycyanide of mercury, mercurochrome (220), potassium permanganate, zinc sulphate, chlorozene, iodine, silver nitrate and its organic compounds such as argyrol, nargol, silvol, protargol, and nucleinate of silver. While each of these drugs had its place in the treatment of these cases, and, at some time seemed especially indicated, silver nitrate was the most universally used of any single one. Perhaps as good, or better, results might have been obtained by some other drug, though, in my opinion, this is very doubtful.

Massage of the prostate and seminal vesicles was done in every case showing involvement of these adnexa, and was continued until the secretions from these organs showed not more than one or two pus cells to the high-power field. The importance of this procedure, properly carried out, can be realized if it is remembered that it is the only means of procuring artificial drainage of these organs in the non-operative treatment of these conditions. In this connection, exception is taken to a recent statement of Cumming and Glenn in advocating vas puncture, that proper massage of the vesicle is difficult, and often impossible, and simply improves the circulation of the vesicles, but does not empty them of diseased secretion and detritus.

Belfield, Squier, Herbert, Cunningham, and many other authors, have shown conclusively that efficient drainage of the prostate and seminal vesicles is the first essential in clearing up the subjective symptoms of these conditions. Cunningham, in a review of one hundred and ninety-four operative cases of seminal vesiculitis, one hundred and twenty-eight of which he placed in the rheumatic group, in this connection says, "Of the one hundred and twenty-eight patients, many had almost immediate subsidence of urethral discharge, yet most had the usual non-operative treatment for varying periods before the discharge disappeared."

Short histories of four cases are given, to further illustrate and emphasize the following points:

The great danger entailed in assuring any patient with a chronic urethral infection, that he is non-infectious (case 1).

The encouraging results occasionally encountered by appropriate treatment in infections apparently deeply situated in the urethral mucosa (case 2).

The persistence of the gonococcus in the male urethra and its adnexa (case 3).

The apparently long incubation period, and the possible absence of symptoms in gonorrheal urethritis (case 4).

*Case 1.* J. M. D. Age twenty-six. Married.

First and only acute gonorrhea in September, 1915. Treated four weeks, when he became a prisoner-of-war in Germany, where he remained twenty-three months with no treatment whatever. Then repatriated to Holland, where he was treated for approximately six months. At this time he still had slight urethral discharge in the morning. Returned to Canada one month later, where he consulted two physicians, who, after repeated examinations of his urethral and prostatic secretions, pronounced his urethritis noninfectious, and advised that it was safe to marry. Married three months later. Four months after marriage, discharge increased. Patient consulted his own physician, who referred him to me one month later. Films of urethral discharge showed abundant pus; a few large diplo-bacilli; no typical gonococci. Treatment by dilatations, topical applications, prostatic massage, etc., was continued every four to five days, with frequent examinations of his secretions, with practically the same findings as above. Two months after treatment had begun, his urethral secretions showed moderate amount of pus and typical Gram negative diplococci, intracellularly. On the same date, film of prostatic secretion showed very abundant pus; Gram negative diplococci, extra and intracellularly.

One month later, films of his urethral and prostatic secretions still showed a few gonococci. Appropriate treatment was continued systematically for a further period of four months, when he was discharged, free from all clinical signs of his infection. He had remained free of symptoms ten months later, when last heard from.

Fortunately, his wife, who was immediately referred to a gynecologist, appeared to have escaped infection, and they are now the parents of a healthy baby.

*Case 2.* W. D. Age twenty-four. Single.

First and only acute gonorrhea in December, 1918, apparently cured after twenty-seven days' treatment. Four weeks later, patient noticed a slight urethral discharge in the morning, which persisted, in spite of regular treatment by self injections and medicines, until February 23, 1920, when he first came under my observation. On this date, films of urine shreds showed a moderate amount of pus; a few Gram negative diplococci, extra-cellularly. Urine on this date macroscopically showed many large filaments and shreds. Prostate, which had previously received no massage, was very tender, large and boggy. Seminal vesicles, both palpable, and extremely tender. Urethroscopy showed orifices of numerous follicles and Littre's glands, surrounded by soft, swollen infiltrations. After the first topical applications to the urethra, his urethral discharge became very much lessened, with consequent encouragement to the patient. Treatment by massage of the prostate and seminal vesicles, bougies, topical applications, instillations, etc., were continued until March 16, 1920, when a film of his urethral discharge, which, by this time, had decreased very markedly, showed a few colon bacilli, and a few Gram negative diplococci, extra and intracellularly (typical gonococci). Prostatic secretion, on the same date, showed a very few pus cells, and no gonococci. On April 15, 1920, he was discharged, free of all symptoms of his infection. Four months after his discharge, he reported, by letter, that he was still free of any symptoms. This patient stated that in the year previous he had spent several hundreds of dollars on medicine alone, and the condition of his urethra alone would indicate that he had been very much over treated.

*Case 3.* A. M. P. Age thirty-one. Married.

Last acute gonorrhea eight years previously. States that he had no extra-marital coitus. Consulted me on August 16, 1920; last coitus ten days previously; three hours afterwards noticed slight urethral discharge, and immediately began injections of 10 per cent argyrol. Film of urethral secretion on this date showed abundant pus; a few Gram negative, extra-cellular, biscuit-shaped diplococci (not typical gonococci). A film of prostatic secretion showed a moderate number of pus cells, but no organisms. He was treated by the usual methods, with prostatic massage once a week. On August 19, 1920, film of urine sediment showed abundant pus; a few typical, Gram negative, intracellular diplococci. Treatment was continued regularly, about

twice a week, until October 22, 1920, when he was discharged, cured. No gonococci were again demonstrated, although five series of films were made in that period. The best evidence that the gonococci had laid dormant in the tissues for several years is, perhaps, the fact that his urethral discharge recurred three hours after his last coitus.

*Case 4.* J. S. J. Age thirty. Single.

First and only exposure to infection, about June 1, 1920. No discomfort, or signs of any infection were noticed until August 15, 1920, when a slight urethral discharge appeared in the morning. Film of his secretion showed a few pus cells; a few colon bacilli; no gonococci. He was put on regular and systematic treatment, which was continued until January, 1921, with very little diminution of his morning discharge, when a film of his urethral discharge showed a few typical gonococci. This patient had a family history of tuberculosis, a personal history of chronic gastritis, and was generally a poor subject. His treatment was continued for eleven and a half months, in all, when he was discharged, cured. This case demonstrates that the gonococcus may become embedded in the male urethra without causing any symptoms of acute urethritis. With the history given by this patient, together with his very mild clinical symptoms, and his long incubation, it was impossible to make a definite diagnosis of gonorrheal urethritis until six months after exposure.

#### CONCLUSIONS

1. Every male, with the slightest symptom of a postgonorrheal infection of the urethra and its adnexa, is potentially infectious.
2. Gonococci may persist in the male urethra, or its adnexa, for years.
3. The gonococcus may become embedded in the male urethra without causing any of the symptoms of an acute inflammation.
4. Unless infections of the adnexa are eradicated, cure of the urethral condition is next to impossible.
5. Vaccines are of little direct benefit in the treatment, except to hasten the eradication of the gonococcus.
6. In the large majority of cases, these infections can be totally eradicated by appropriate treatment, irrespective of the length of time elapsed since the original infection.

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## THE OPERATIVE TREATMENT AND PATHOLOGY OF ACUTE EPIDIDYMITIS<sup>1</sup>

JOHN H. CUNNINGHAM AND WARD H. COOK

Epididymotomy for acute gonorrheal epididymitis as first advocated by Dr. F. R. Hagner in 1902 is a procedure, the value of which is generally recognized by this Society. The object of this communication, aside from brief mention of certain clinical and operative features, is to consider the pathology of the subject.

Clinically, the indications for performing epididymotomy depend chiefly upon the severity of the process. Those patients with an unusually severe local and general reaction and those with recurrent acute and subacute epididymitis form the group in which the operation is advisable. Comparative results of severe epididymitis treated expectantly and by epididymotomy greatly favor the operative treatment, both from the viewpoint of relieving suffering and shortening the course of the disease. Moreover, the relief of the acute inflammation in the epididymis by operation frequently has a beneficial influence on the associated condition in the upper genital structures, and recurrent epididymitis on the side operated upon is rare. Following epididymotomy, treatment of the diseased seminal vesicle and prostate may be initiated earlier in consequence of the epididymal drainage, and the morbid processes in these structures respond more rapidly to treatment, presumably because they are not being fed, as it were, by infectious material from the diseased epididymis.

The matter of sterility resulting from bilateral epididymitis treated by epididymotomy as compared with non-operative treatment has entered the minds of all of us, I dare say. For obvious reason much accurate data upon such a matter is difficult to obtain, yet, such as it is, causes the feeling that sterility

<sup>1</sup> Read at the meeting of the American Urological Association, New York, April, 1920.

following bilateral epididymotomy is not greater than by non-operative treatment, and probably less. In 22 patients upon whom I have done a double epididymotomy, 12 have been proven to have spermatozoa (or approximately 55 per cent); 5 without spermatozoa (or approximately 22 per cent); and 5 in whom the condition is unknown. Hagner, in 3 double epididymotomies, proved 2 to have spermatozoa, and Crosby in 2 double operations investigated but one, and found this one to have spermatozoa. Contrasting this information with that expressed by Finger in a series of 242 patients with epididymitis, of whom 207 were proven to be without spermatozoa (approximately 85 per cent sterile), would seem in favor of operation. The difference of 57 per cent with spermatozoa following treatment, as mentioned by Finger, and the series mentioned by Liegeois of 28 bilateral cases with the absence of spermatozoa in 21 (75 per cent), seems extraordinarily out of proportion, but it may be fairly interpreted, however, that the number of patients with a zoöspemia following operation is not larger, at any rate, than those treated by non-operative methods, and the evidence, such as it is, greatly favors epididymotomy.

The gross pathology as noted at operations shows that the scrotal tissue is often edematous and the tunica vaginalis thickened and acutely inflamed. Fluid in the tunica vaginalis has been almost constant, the exception being in a small percentage of cases (not over 5 per cent), where there has been a formation of much fibrin replacing the fluid and agglutinating the epididymis and sometimes the testicle with the parietal layer of the tunica vaginalis (a late process). The hydrocele fluid is usually clear and without organisms; but in a few of the severe reactions the fluid has been found cloudy, containing leucocytes in large number, but no organisms.

The inflammation in the epididymis has usually, but not always been confined to the tail, and the body and also the head have been found involved in many instances; in fact, some patients have shown more activity of the process at the head than at the tail. The testicle, except for a surface injection or being buried more or less in fibrin, has not been grossly diseased.



Upon puncture of the inflamed epididymis gross pus has been observed in about 60 per cent of the cases, varying from a drop to about a dram. Smears made of the material from these punctures when gross pus has not been evident have never failed to show pus microscopically. The organisms found in the pus have never been other than the gonococcus, and this organism has been recovered in about 80 per cent of the cases examined.

Bronnum has found a gonococcus in the secretion recovered from the seminal vesicle on the same side with the epididymitis in about 80 per cent of cases and in the other 20 per cent leucocytes without the organism. His percentage of positive findings in regard to the organisms in the seminal vesicle material have been much greater than mine. The material from the prostate and seminal vesicle has rarely been examined during the acute stage of the epididymitis, but prior or subsequent to it, which may account for my less frequently recovering the organism, it being recovered in about 50 per cent of the cases; while pus, desquamated epithelium and more or less detritus, dependent upon the vesiculitis, have been a constant observation.

Realizing the presence of associated inflammation in the seminal vesicle we have employed the Belfield operation at the time of the epididymotomy in twelve patients, but do not feel that these patients have done better than those in which this procedure has not been employed.

Induration remaining in the epididymis following epididymotomy has usually disappeared within two months, and the discrete indurated sclerotic area, usually observed following the subsidence of an acute epididymitis, treated by non-operative measures, seldom remains.

The development of a hydrocele following epididymotomy has been observed in about 5 per cent of my patients, and usually occurs weeks after the operation. This complication has occurred in patients where the tunica vaginalis is much inflamed at the time of operation. In a few instances the tunica vaginalis has been resected with a view of overcoming this secondary feature. As a result an active reaction in the scrotal tissues has occurred in some. For this reason, and the reason that a very

small percentage of cases develop hydrocele, it is considered that the removal of the tunica vaginalis, as a step in the operation, is not advisable.

The clinical conclusions are that epididymotomy is a rational procedure for active, acute, and recurrent acute and sub-acute epididymitis, being the application of the general surgical principles of drainage to an inflamed structure with the same beneficial results here as in other structures.

The operation is, however, an attack on but one organ in a series of organs infected, and the inflammatory process in the seminal vesicles and prostate still remain in some degree and require subsequent treatment. It is believed, moreover, that drainage of the epididymis has a beneficial influence on the inflammatory process in these organs, as they are freed from the influence of the products of inflammation draining by them from the infected epididymis, and in consequence of this the duration of treatment of the seminal vesicle, prostate and urethra is materially lessened by the operation of epididymotomy.

The immediate effect of the operation is a rapid relief of pain and the high temperature and leucocytosis drop rapidly to normal, and the individual is able to return to his duties about five times as soon, following the operation, as when treated by non-operative methods.

Recurrent epididymitis following epididymotomy is rare, and sterility is less often a permanent defect.

The pathological study here presented has been made upon tissue recovered at operation in 25 selected cases. Similar material, but chiefly from early stages of the disease, was studied by Dr. F. B. Mallory and the results reported by Cunningham in 1913.<sup>2</sup> He observed that within three days the ductus epididymidis was distended with polymorphonuclear leucocytes, among which were found phagocytic endothelial leucocytes. "In places the lining epithelium is destroyed and the exudation is directly continuous with an extensive infiltration of the connective tissue with similar leucocytes. In places the tissue has

<sup>2</sup> Surg. Gyn. & Obst., xvii, 749-752; Trans. Am. Ass. G. U. Surg., viii, 154-162.

been destroyed and dissolved so that small abscesses exist." Our present study confirms the observations recorded in the earlier paper. Figures 1 to 3 inclusive show the establishment of a virtual empyema of the ductus epididymidis and in figures 4, 5, and 7 the mechanism of abscess formation is illustrated. So far there is nothing to indicate a gonorrheal etiology of the lesion. It is simply an ascending infection which at the onset exhibits the usual signs of acute inflammation. There is intense hyperemia and edema of the connective tissue. The tubular epithelium becomes swollen. Polymorphonuclear leucocytes emigrate from the dilated blood vessels of the stroma and, making their way through the mucosa, accumulate in the lumen of the ductus epididymidis which in consequence of this becomes greatly distended. Large mononuclear cells appear in the lumen early, at first in small numbers, then gradually increasing. In the early stages lymphocytes are found in the edematous stroma, where they usually outnumber the polymorphonuclear leucocytes. Prompt proliferative activity on the part of the fibroblasts at the periphery of the acute inflammatory reaction is a conspicuous feature. As early as thirty hours after the onset, mitosis has been observed in swollen fibroblasts. Fibrin soon makes its appearance in the peripheral stroma and on the tunica albuginea. The amount varies but there is usually enough to be conspicuous and it occurs in relatively coarse blotchy masses in the stroma. In material examined not later than five days after the onset, organization of this fibrin by the proliferating fibroblasts with the aid of recently formed capillaries is already well advanced (fig. 6). In these early stages it has been comparatively easy to secure the gonococcus in cultures from the exudate and to observe it in the lesions.

It is often stated that abscess formation is uncommon in gonorrheal epididymitis. That as a rule there is no clinical evidence of abscess formation, we are not prepared to dispute, but microscopic and even gross examination of the tissues shows the development of small abscesses to be of frequent occurrence. The origin of these may be seen in figure 4, where a small area of lining epithelium has disappeared, while through this aperture

the purulent contents of the tubule becomes directly continuous with polymorphonuclear leucocytes infiltrating the connective tissue. It would seem probable that abscesses may be produced in this way in the case of an ascending epididymis infection of whatever etiology. Indeed, in the case figured, although a very old gonorrheal involvement was known, it seems doubtful that the gonococcus was the present cause. Yet similar pictures are to be found in cases in which this organism is definitely implicated. Compare, for example, figures 5 and 7. Acute ulceration with a diphtheritic type of exudate was noted at one point in a dilated tubule of a case in which both the staphylococcus pyogenes albus and the gonococcus were obtained in culture. In this case there was considerable hemorrhagic as well as purulent exudation into the connective tissue. The gonococcus abscess as studied in this series of cases differs from the typical staphylococcus abscess chiefly in the absence of a conspicuous central zone of necrotic tissue and in the sluggishness with which repair ordinarily takes place. The abscess does not rapidly dissolve its way through to a surface onto which its septic contents may be discharged. It heals slowly, with the gradual dissolution and resorption of the polymorphonuclear leucocytes which are replaced by a loose collection of endothelial leucocytes which in turn finally disappear as fibrosis occurs. During this stage there is sometimes demonstrable within the confines of the healing abscess the irregular and uncertain outline of the injured ductus epididymidis. A more advanced stage in the healing of such a lesion is shown in figure 10.

The inflammation accompanying gonococcus infection is characteristically chronic. There is an initial acute stage during which the organisms are easily found in the abundant purulent exudate on the surface of the inflamed part. This stage differs very little from any acute inflammatory process. But the rapidity with which repair begins while active inflammation still exists is a noteworthy feature. The deep seated exudate of fibrin which so often occurs is evidence of the extent to which the injury reaches and it is here in the tissue somewhat remote from the multiplying organisms that reparative activity is first

observed. As the inflammation persists within the ductus epididymidis certain changes take place, often permanent, and always of a nature calculated to interfere with normal function. The normal cylindrical ciliated epithelium, with its inconspicuous basal layer of cells, sometimes becomes replaced by stratified squamous epithelium resembling that of the epidermis (fig. 8). The tubular lumen may be alternately narrowed and widened, even in the same case (figs. 8 and 9). The contents change in cellular character. Mononuclear cells, phagocytic for other and for fat droplets, appear there in considerable numbers. The submucosa is broadened by the infiltration of endothelial leucocytes and especially plasma cells and lymphocytes. There is a conspicuous increase in connective tissue between the smooth muscle fibers of the tubular wall and even between the convolutions of the ductus epididymidis. In certain cases (figs. 10 and 11) this connective tissue shows a massive infiltration with lymphoid cells. When resolution of this exudate finally does take place we may be left with a permanently stenosed tubule or one moderately dilated and stiffened. In such a healed case (fig. 12) there may be a striking absence of muscle fibers in the wall.

Such a pathology as here outlined, demonstrating a rapid destructive process in the tubules and intertubular tissue and ending with permanent defects in these tubules, argues in favor of supplying surgical drainage early if the process is shown clinically to be severe; for upon the early termination of the destructive inflammatory process will depend the prevention of permanent impairment of the function of the ductus epididymidis.

#### ADDENDA §

Shortly after the reading of this paper there appeared an interesting contribution by J. Wolff (*Beitrag zur pathologischen Histologie der gonorrhoeischen Epididymitis*, Virch. Arch. 228, 227-246, 3 figs.). Besides describing a case of his own of rather uncertain etiology, he reviews the more important European accounts of the microscopic anatomy of this condition. These

begin with the Danish of Scheperlern in 1871, who found the walls of the ductus epididymitis entirely destroyed by a lymphocytic infiltration and the surrounding tissue infiltrated with pus cells. No further advance was made until the description of microscopic abscess formation with consequent progress of the affection via interstitial tissue and lymphatics and the mention of epithelial metaplasia in the ductus deferens by Audry and Dalous in 1903. A more nearly adequate description appeared in the same year by Nobl who worked with post mortem material from one case. Both he and in the following year Sellei, studying both acute and chronic cases, noted the connective tissue increase around the tubules. Baermann, in 1905, gave special attention to the finer changes in the mucosa and was the first to record the presence of gonococci in the sections from acute cases. The stenosis and closure of the tubules in chronic and healed cases is due not only to contraction of new-formed connective tissue, but according to Delbert and Chevassu (1908) is more often caused by epithelial proliferation.

Wolff describes one case in which the testicle was removed at operation three weeks after onset of acute epididymitis following trauma and twenty-four hours after return of previously subsided symptoms. Microscopically both acute and chronic changes were found. The early changes in the mucosa and interstitial tissue and the metaplastic stratification of the epithelium resemble those described by us as well as by earlier authors. In contradistinction to Baermann he finds the peritubular elastic sheath completely disrupted. The formation of granulation tissue in the tunica propria and its extension peripherally as well as towards the lumen is well described and compared with the similar development in gonorrheal salpingitis.

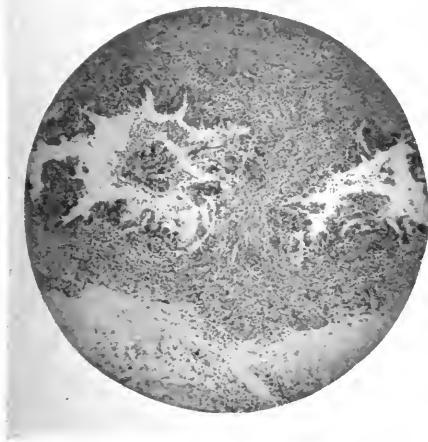


FIG. 1.



FIG. 2.

FIG. 1. HEAD OF EPIDIDYMIS FROM A CASE OF THIRTY HOURS DURATION

The gonococcus was obtained in pure culture from the lesion and observed in smears from the pus. At operation a small abscess containing thick creamy pus was found and opened. The photograph shows intense hyperemia and edema of the stroma. The epithelium of the tubules is swollen and the dilated lumen contains polymorphonuclear leucocytes which can be seen in active migration through the mucosa from the infiltrated stroma.

FIG. 2. ENORMOUS DILATATION OF A PUS-FILLED TUBULE IN THE HEAD OF THE EPIDIDYMIS FROM AN ACUTE CASE IN WHICH THERE WAS ABSCESS FORMATION

Gonococcus, together with staphylococcus pyogenes albus was obtained in culture from the pus.

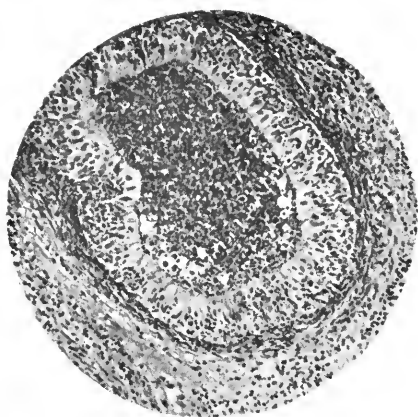


FIG. 3.



FIG. 4.

## FIG. 3. THE DUCTUS EPIDIDYIMIDIS MORE HIGHLY MAGNIFIED

Showing the lumen crammed with polymorphonuclear leucocytes which are still migrating through the swollen mucosa.

## FIG. 4.

This patient had had gonorrheal epididymitis twenty years before the present acute attack which was of three days duration and occurred during convalescence from an illness diagnosed as influenza (February, 1918). At operation the tunica vaginalis contained fibrin and seropurulent fluid. The epididymis was swollen and injected, the injection being more marked focally in the head and body. Thin sero-pus was revealed in the head, and thick pus in the body upon puncture. Cultures showed an unidentified organism of the colon bacillus group. The photograph shows a minute rupture of an acutely inflamed tubule with extravasation of pus into the stroma.



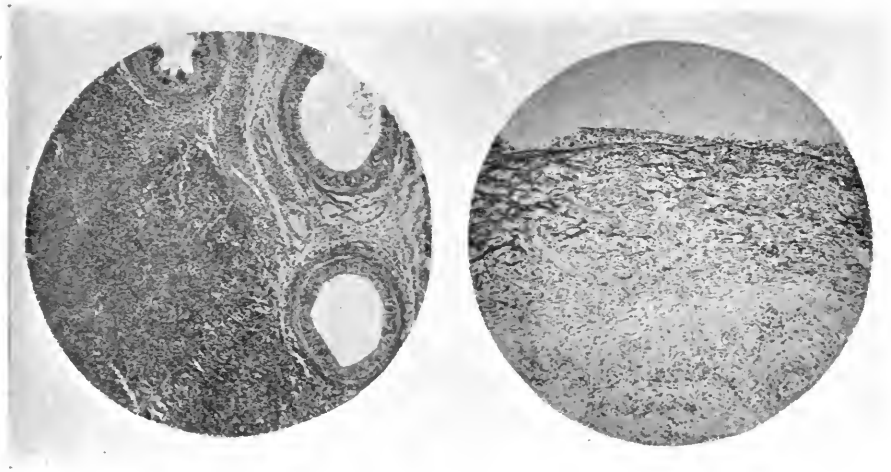


FIG. 5.

FIG. 6.

FIG. 5. AN ABSCESS SPREADING BETWEEN CONVOLUTIONS OF SUBSTANTIALLY NORMAL TUBULES

FIG. 6. THE TUNICA VAGINALIS IN AN EARLY CASE (THE SAME AS FIG. 2)

Exhibiting the usual marked exudate of fibrin on and beneath the serous surface. Organization by granulation tissue has commenced.

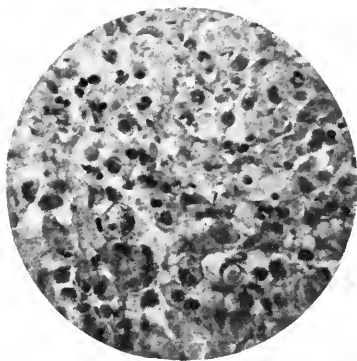


FIG. 7.



FIG. 8.

FIG. 7. A HIGH POWER VIEW OF THE CONTENTS OF A RECENTLY FORMED ABSCESS  
IN A FULMINATING CASE OF GONORRHEAL EPIDIDYMITIS

Note the presence of numerous spermatozoa among the leucocytes. The duration of the epididymitis was two days and it began twenty-four hours after the onset of a first attack of gonorrhea.

FIG. 8. STRATIFICATION OF EPITHELIUM WITH MARKED CONSTRICTION OF THE  
TUBULAR LUMEN IN A CHRONIC CASE

A few polymorphonuclear leucocytes occur in the mucosa and in the lumen, whereas many plasma cells are present in the widened submucosa.



FIG. 9.

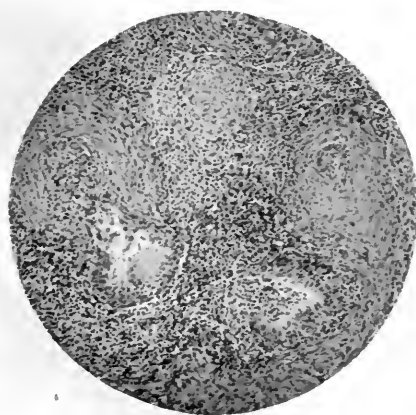


FIG. 10.

FIG. 9. CHRONIC EPIDIDYMITIS WITH GONORRHEAL HISTORY

The mucosa is thin but the epithelium is stratified. The cellular content of the lumen is variable, but polymorphonuclear leucocytes predominate. Marked infiltration of the submucosa with plasma cells and lymphocytes, and fibrosis of the muscular coats gives a picture strikingly like that seen in the typical chronic gonorrheal salpingitis.

FIGS. 10 AND 11. PHOTOGRAPHS ARE ALSO MADE FROM A CASE OF CHRONIC EPIDIDYMITIS IN WHICH THERE IS EXTENSIVE DIFFUSE FIBROSIS AND INFILTRATION WITH LYMPHOID CELLS

The ductus epididymidis is notably distorted and constricted. The muscular coat has disappeared in places.

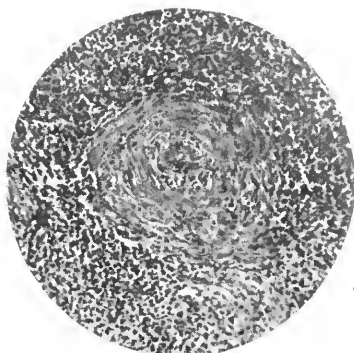


FIG. 11.

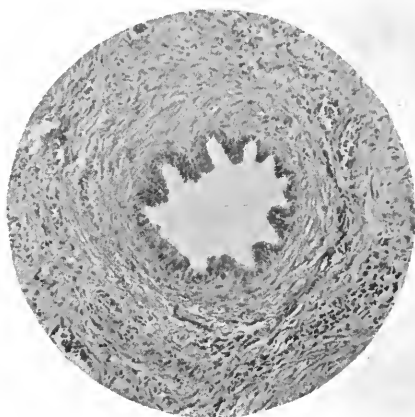


FIG. 12.

## FIG. 12. FROM A CASE OF HEALED GONORRHEAL EPIDIDYMITIS

There had been many recurrent attacks during the one and a half years' duration of the disease. Operation was undertaken for relief of pain referable to the tail of the epididymis in which was a hard nodule. The section was taken through this nodule and shows marked fibrosis with stiffening of the ductus epididymidis. Only a very few scattered lymphocytes persist in the stroma. The ductus is patent and empty.

## SUCTION DRAINAGE WITH PRESENTATION OF AN APPARATUS

MEREDITH F. CAMPBELL

*From the Urological Service of Bellevue Hospital, New York*

In an attempt to solve the problem of satisfactory post-operative drainage of the urinary organs, especially the bladder after prostatic surgery, we have—on the Urological Service of Bellevue Hospital—utilized in turn most of the drainage systems and contrivances advanced to date. The dryness of the wound being our criterion, success in most cases has been mediocre, in others, the methods have failed totally. Since it is of utmost importance that the patient be kept dry with a view to the prevention of post-operative medical complications and to the promotion of quickest possible healing, a dry dressing, and by the same token, a dry wound, is most desirable. To this end we have constructed a system herewith presented which in its entirety we have not found previously described and which in our hands has proven most efficacious.

Davis (1) has given a brief and concise historical summary of the various advances made and apparatus used in urinary drainage up until 1916. Since then others have presented systems and apparatus to accomplish the same end. Chiene (2) in 1880 called attention to the use of the syphon principle, draining the bladder, however, through a urethral catheter rather than through a suprapubic wound. Subsequently numerous others have described modifications of syphon drainage, a U-bend or what works equally well, a loose knot tied in the tube having been found to produce a more perfect syphon suction. Suction as an adjuvant to the promotion of better drainage was first suggested by Potain (3) and was utilized in empyema cases. The passage of water from an elevated reservoir through a vertical tube into which another tube enters at an angle creates a vacuum

in the latter tube. The apparatus of Potain depended on this physical principle for its suction force. Fenwick (4) later applied the apparatus to vesical drainage and since his time various modifications have been described the most recent of which are those of Hinman (5) and Pirondini (6). In 1909 Kenyon and Poole (7) obtained a more powerful suction by using a filter pump.

As there have been many types of apparatus devised to create the drainage force, so too have there been many types of tubes constructed to act as the suction tip proper. The simple catheter has been found by many to become easily clogged by blood, mucus and tissue. Heaton (8) was the first to present the "tube within a tube" principle. An outer larger tube acting as a caisson is inserted into the wound. A smaller inner tube goes nearly to the bottom of the outer tube — not coming in contact, however, with the tissues — and is surrounded, theoretically at least, by an air column. Kenyon (9) in 1913 described his modification of the Heaton tube. As fluid flows in through the holes at the inner end of the outer tube, it is sucked up by the inner tube. Small catheters or tubes for irrigating purposes have been added to the drainage tubes (Marion, Martin) thus preventing, by frequent irrigations, the retention of foreign bodies and mucus. Fantastic glass, rubber, and metal appliances for receiving the urine as it flows out of the bladder wound have been designed and advocated by others. They do not adapt themselves, however, to those cases in which early wound closure is desired.

The apparatus herewith described gave such satisfactory results from the first that after a few months it was decided to review the literature with a view to presentation. We found that in a manner it is a hybrid of the filter-pump-suction and piping system of Kenyon and Poole (7) and the double tube suction tip of Heaton—later modified by Kenyon. In cases of drainage of a clean bladder the simple catheter works admirably. Nowhere, however, was I able to find described a manometer safety valve or suction pressure gauge and governor such as here described and since we consider its addition essential to

the safe use of a potentially strong suction, we believe it merits publication. Others (Perthes (10), Davis (1)) have described manometers but these have been so complicated or so difficult of manufacture that their more general use seems not likely. The utter simplicity and ease of construction of the instrument we are using will, I am sure, appear readily.



FIG. 1

The outfit consists, as shown in figure 1, of a small filter suction pump attached to a  $\frac{1}{2}$  inch gas pipe which is distributed along the floor beneath the beds. At each bed is a gas stop-cock (see fig. 2, *SC*) for rubber connection. The collection bottle (*U*)—we use a 3-gallon packing bottle—is fitted with a 2-hole rubber stopper with glass tubes, one of which (*B*) is connected to the suction catheter (*C*) in the wound, the other (*A*) with the stop-cock. The manometer (*M*) (fig. 3) may be introduced at any point in the system. We have found it convenient to

place it between the pump (*P*) and the gas pipe by means of a T-tube connection (*T*). The suction tip may be fastened into the cavity to be drained by adhesive strips.

As shown in figure 4, the manometer consists of three parts, an outer tube (*C*), an inner tube (*A*), and a rubber stopper (*B*). For the outer part any glass test-tube of a diameter of  $\frac{3}{4}$  to 1 inch may be used. We have found the New York Board of Health Wassermann tube very convenient. The inner tube or

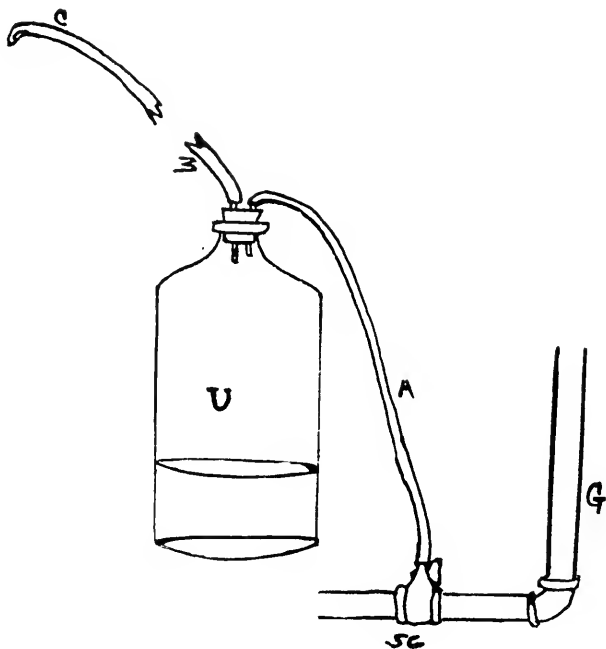


FIG. 2

suction-pressure gauge is made by filing off an ordinary 15 cc. laboratory pipette at the lower end (*x*). This piece is introduced through the hole in the rubber stopper. In order to admit air into the tube when the stopper is inserted, a niche (*y*) is made in the latter. About  $\frac{1}{2}$  inch of mercury is then poured into tube (*C*) and the inner tube and stopper inserted. As suction is applied to (*A*), the mercury will rise in this tube and will reach a certain height, determined entirely by the depth of immersion



and force of suction. As stronger suction is applied, enough mercury will have been drawn in so that the lower level (*L*) of the column is at the bottom of tube (*A*) and with slight additional suction air will be drawn through from the outside. If one desires, for example, a maximum negative pressure of 20 mm. the tube is so regulated — by raising or lowering in the mercury,



FIG. 3

slipping it through the rubber stopper — that a column 1 cm. high is attained before the air bubbles through (principle of U-tube barometer). When suction greater than 20 mm. is produced the air rushes through the mercury and the pressure in the entire system is thus maintained at 20 mm. or less. The range of safety for the suction is reasonably large and one may easily estimate the negative pressure present by noting the height

of the mercury in the inner tube, it being remembered that one inch is about 25 mm.

We have found a suction of 20 mm. is ample. A negative pressure of 30 mm. may be exerted on the bladder mucosa without danger of ulceration or diapedesis. For drainage of pus cases (infected hydronephrosis, perinephritic abscess, etc.) a much greater pressure has been used with no untoward results.

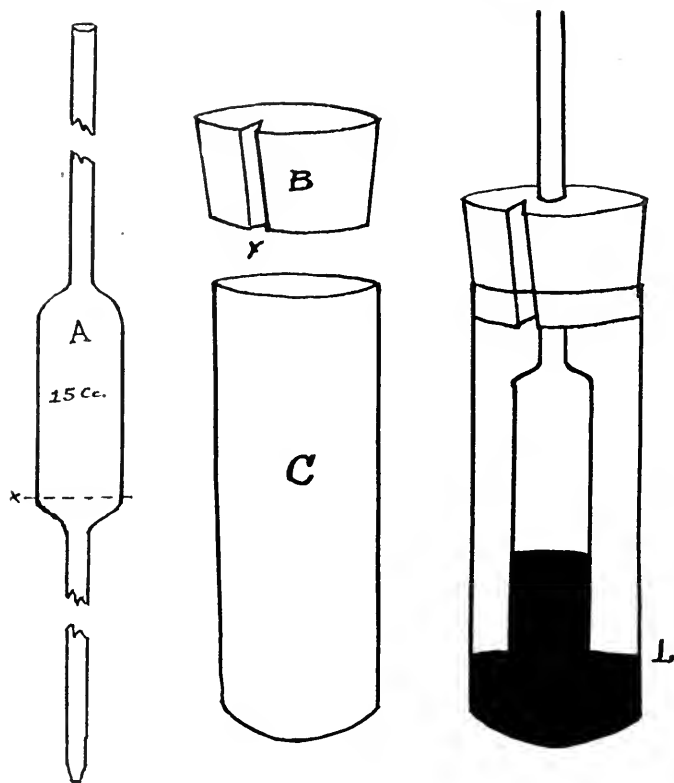


FIG. 4

This apparatus has been found to save the patient from much discomfort and needless physical risk and, from an economic standpoint, saves dressing material. It has been used successfully in practically every type of urological case. For use in a large hospital, an apparatus must of necessity be simple and require as little attention as possible and be one that can readily be adjusted by the nurse should the occasion arise.

## CASE REPORTS

*Case 1.* An operation for bladder diverticulum was performed. Subsequently the wound manifested infection, was opened and supra-pubic syphon drainage instituted. The urine, in spite of massive doses of sodium acid phosphate, was persistently alkaline, the syphon continually became clogged or for other reason did not work, the patient was perpetually wet, and in spite of frequent irrigations and change of dressings coupled with great care, a heavy phosphatic incrustation formed in the wound and extended into the bladder. The highly unsatisfactory condition of the wound and the great discomfort of the patient prompted us to construct the previously described apparatus and using a simple catheter for suction tip, actual suction was applied. On the second day the wound was soaked for a half-hour with 1 per cent acetic acid and all incrustations cut away. Forty-eight hours later healthy granulations were found. As the wound closed smaller catheters were substituted and on the tenth day suction drainage was discontinued, a small sinus being present which closed satisfactorily a little later. From the first, use of the suction kept the patient absolutely dry.

*Case 2.* A perinephritic hydronephrosis (secondary to rupture of renal pelvis) containing 65 ounces of thin urino-purulent fluid was drained through the loin. On account of the presence of pus, a double tube (Heaton) was used in this case. For the first five days the output averaged 30 ounces a day, about six ounces of which were thick pus. As nephrectomy was to be performed subsequently, no attempt was made to close the wound early. Nevertheless the tissues healed readily about the tube, the wound being so dry that the granulations stuck to the dressings and bled when the latter were removed. Suction drainage was continued for ten days at the end of which time the output was chiefly thick pus, very little urine being noted. The patient was at all times dry with the exception of the third day when the nurse unwittingly turned the water off.

*Case 3.* A ureterotomy was performed for stone through a rather extensive Gibson incision. A  $\frac{1}{2}$ -inch heavy rubber drainage tube was inserted to the site of the ureter through a small incision 2 inches below the large wound. A no. 22 soft rubber catheter was then passed nearly to the lower end of the large drainage tube and suction applied. For the first five days the urinary output was 12 to 20 ounces daily when it rapidly diminished and stopped on the seventh day—a small

amount of pus being withdrawn by suction. On the eighth day suction was discontinued and a small split rubber tube inserted through the muscles. At no time was the dressing moist. The large incision healed rapidly by primary union and in a short time the lower wound was entirely closed. It is noteworthy that, in cases such as the above, if the dressing becomes urine soaked, the primary incision is almost certain to become secondarily infected and there is both prolonged convalescence and increased tendency to herniation.

*Case 4.* A pyelotomy and ureterotomy was done for removal of stones. A large rather stiff rubber drainage tube was inserted to pelvis of kidney and suction drainage begun. For the first few days the daily urinary output was 25 to 30 ounces on this side. Thirteen days after operation the output was 15 ounces and contained 2 ounces of thick pus. Rapidly the urine diminished in amount and the pus increased. On the seventeenth day suction was discontinued for twenty-four hours but it was found that the dressing became quite damp and suction was resumed again for four days at the end of which time there was but little moisture on the gauze after twelve hours. Except on the second day when the rubber tubing became kinked under the patient, the wound and dressings were absolutely dry, the granulations adhering firmly to the gauze when removed.

*Case 5.* A suprapubic cystotomy for drainage was done on account of prostatic hypertrophy. An 18 F. catheter was inserted into the bladder and suction drainage begun. This was continued for ten days previous to prostatectomy and again carried on for six days after the second stage operation, during all of which time the patient was dry with the exception of twice when his suction tube became kinked. The urinary output of this patient was 60 to 70 ounces daily.

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## ACKNOWLEDGMENT OF PRIORITY FOR THE TREATMENT OF IMPACTED CALCULI IN THE LOWER END OF THE URETER RELEASED BY FULGURATION

HUGH H. YOUNG

In the Journal of Urology for February, 1918 (vol. 2, no. 1), I published an article entitled "The Employment of the High Frequency Current for the Extraction of Calculi Incarcerated in the Lower End of the Ureter," in which I reported three cases in which calculi were impacted in the intravesical portion of the ureter, which presented beneath the calculus a tight orifice and in which by means of a high frequency current a linear burn was made through the mucous membrane thus liberating the calculi, which passed a day or two later.

According to my best knowledge and belief, the method was original, though no claims were made for it in that regard. Since the publication of this paper, Dr. H. D. Furniss has called my attention to the fact that in May 17, 1913, he published in the Journal of the American Medical Association an article entitled "Impacted Ureteral Calculi Released by Fulguration." The description of his case is quite interesting and is here given almost in full.

The case is of interest in that it shows an error of diagnosis and offers a suggestion as to a new method of treatment.

*Patient.* Mrs. B. G. Admitted to the Post-Graduate Hospital, July 16, 1912.

*History.* Eleven years previously she had a sudden attack of pain in the right lumbar region. This lasted for a day and she passed some gravel. There was no similar trouble until three months ago. Since that time she has had frequent and urgent urination and at times sudden cessation of the urinary flow, before the bladder was empty. She has noticed that the urine is turbid and contains blood. In the past three months she has had much pain in the right lumbar region.

*Examination.* Radiographs were made and no shadows of stone were seen. There was nothing to be palpated in the kidney regions. Vaginal examination showed a hard mass on the right side of the bladder. The catheterized specimen of the urine showed a large amount of pus and some blood. Cystoscopy: In the region of the right ureter was seen a mass about the size of a pigeon's egg, with bullous edema on the periphery, that was taken to be a flat-based papilloma and, because of the induration as felt through the vagina and the bullous edema was regarded as in all probability malignant.

*Treatment.* The mass described above was fulgurated on July 20 with the D'Arsonval current, and again three days later. On examination a week after the second treatment, I was surprised to see protruding from the portion of the supposed tumor over the part fulgurated a large, black, rough stone. I suggested to the patient that she come into the hospital and allow me to remove the stone.

The patient became frightened and did not return. I wrote her to call on me and she did so on January 31, 1913. At this time she stated that she had had a number of attacks of lumbar pain since I saw her last, and one quite recently. Cystoscopy showed two stones almost the size of pigeon's eggs free in the bladder. The orifice of the right ureter was about the size of a lead-pencil. The mass that had appeared like a papilloma had disappeared.

An unsuccessful attempt was made to crush these stones with a lithotrite under local anesthesia. I directed that she have radiographs made of the whole urinary tract, as the frequent attacks of right renal pain indicated that possible presence of other stones in the kidney or ureter. After this the patient went from under my attention and I have heard nothing from her since.

There are several noteworthy features in this case. The first is the large size of the stones that had come down the ureter. I do not think there was any increase in size of the stones after their escape into the bladder, as the appearance was the same, and neither was larger than the estimated size of the one seen just after the fulguration. Second, it is very easy to mistake such a condition for a flat-base papilloma. In all cases in which a supposed growth is situated over the vesical orifice of the ureter, and the meatus is not to be seen, the thought of stone should be entertained. In such instances a good radiograph of the lower end of the ureter will clear up the diagnosis. Third, where haste is not necessary, on account of symptoms due to ureteral obstruction, fulguration of the bladder over the stone offers a simple and blood-

less method of releasing these stones. It takes about a week for the fulgurated tissue to slough away and let the stone into the bladder.

Although I made no claim for priority, it gives me great pleasure to refer to Dr. Furniss's case at this time and to call attention to the priority which he deserves for his suggestion of this valuable method of treatment, which offers an excellent means of removing calculi incarcerated within the intravesical portion of the ureter.





## LYMPHO-CYSTIC URETHRAL LESIONS: AN EVIDENCE OF SYSTEMIC TUBERCULOSIS

P. S. PELOUZE

*Philadelphia*

In 1915<sup>1</sup> I reported nine cases of tuberculosis showing lympho-cystic lesions in the posterior urethra and ventured the opinion that they were in some way the result of the demonstrated tuberculosis. In 1917<sup>2</sup> a further report was made upon these urethral lesions and fifty-one cases, including the above were cited in which there were evidences of active tuberculous lesions in various portions of the body.

As was to be expected, much doubt was voiced as to the correctness of these observations but after a close study during the last seven years I have no hesitancy in taking a decided stand upon the matter and feel that the clinical and necropsy data herein presented are of sufficient scientific accuracy to support the contention. As much of the doubt was due to an apparent misconception of my claims it would, perhaps, be well to state them briefly before proceeding further with a discussion of the subject.

*The chief contention is to the effect that patients presenting these urethral lesions have somewhere in the body an active tuberculous focus.*

The entire clinical course of these cases proves the urethral lesions to be due to systemic causes primarily; local causes playing only a secondary part. Further, the preponderance of demonstrable tuberculosis in these patients gives convincing evidence that this systemic condition is tuberculosis.

There has been no thought nor claim that the urethral lesions were ever a primary urogenital tuberculosis, that the associated

<sup>1</sup> New York Medical Journal, October 16, 1915.

<sup>2</sup> Journal of Urology, August, 1917.

tuberculosis was of necessity in the urogenital tract nor that the urethral lesions were of necessity truly tuberculosis.

As a matter of fact, the lesions seem rarely to be tuberculous tissue and the associated tuberculosis is most commonly in the lungs. True, there are some patients presenting the urethral lesions in whom no such focus can be demonstrated but, even in these, a course of anti-tuberculous treatment will cause the entire disappearance of the urethral lesions without any urethral treatment. In some of the cases giving negative findings for tuberculous at first, neglect of hygiene has later made it possible to demonstrate tuberculous lesions of varying gravity. It must be admitted that such experiences raise a distinct question as to our ability to find the smaller foci of active tuberculosis and, yet, there has never been any doubt about the enormous importance of their recognition or the value of lesions arousing suspicion that there existed a tuberculosis.

#### THE LESIONS AND THEIR CYCLE OF DEVELOPEMENT

The earliest form of lesion recognizable through the cystoscope is a minute area very slightly raised above the surrounding mucosa (fig. 4). It is recognized because it is paler than the mucous membrane surrounding it which rarely seems inflamed. Usually at this stage it is circular in outline but it is by no means uncommon to find distinctly elongated, fusiform, or sausage-shaped types (figs. 9 and 10). These are most often observed as small swellings on the ridges at the posterior attachment of the verumontanum. They are also seen as larger ridges running distally from the vesical sphincter at the junction of the median prostatic commissure with the lateral lobes and are always in the long axis of the urethra, never running transversely. It is not uncommon to find at the vesical neck a small cyst superimposed upon a larger one (fig. 7).

As to the number of the lesions there is no rule, as they are at times solitary, more often multiple, either isolated or in groups. Their cycle of development seems to be as follows: There is a small submucous accumulation of lymphoid cells which apparently goes on to liquefaction. The material lying di-



FIG. 1. THE USUAL LOCATIONS OF THE LESIONS (DIAGRAMMATIC)



FIG. 2. "CYSTS OF THE FOSSULA AND DECLIVE" (BUERGER)

rectly under the intact basement membrane of the mucosa, pushes toward the urethra and forms a definite cyst covered by the practically normal mucosa. When, through instrumentation, this mucosa is ruptured a milky fluid escapes and there is left a circular abraded surface from one edge of which hangs a

shred of mucosa. It takes about one month for the earliest recognizable lesions to become cysts. Once the cysts are formed they seem not to rupture spontaneously but to persist until such time as the true reparative processes cause their disappearance without scarring or other evidences of their having been present. They may be increased in number but the older ones remain. Also, if traumatic rupture occurs, the abraded surface very quickly covers with mucosa and a new cyst seems to form on the same spot within eight weeks. They are true submucous lesions and do not in any sense involve the underlying prostatic tissue.

The study of the accompanying illustrations will show that they bear very little resemblance to edema bullosum. The individual elements of the latter show no blood vessels on their surfaces, have a watery translucent appearance and are confined to the bladder and not found in the posterior urethra. The well known tuberculous edema and the papillary carcinoma, like edema bullosum, may be of the same contour but are easily differentiated by their deep red.

Inquiry among urologists convinces me that most are looking for some new lesion they have never seen before, whereas, the cystic forms of those in question have been illustrated many times in text-books as "cysts, adenoids or glandular lesions of the prostatic urethra." Two of these illustrations (figs. 2 and 3) are herewith reproduced and the authorship of each credited. A number of original drawings are also shown which give one a good idea of the various types of lesions. Figure 1 shows diagrammatically the usual locations in which the growths are found.

#### PATHOLOGY

From the fact that early in these studies tissues from the urethra of two living patients and one autopsy case were tuberculous, it was surmised that possibly the lesions were in themselves always true tuberculosis. Further tissue studies raised a doubt about this matter which doubt was voiced in my previous paper. A number of efforts have been made since to obtain for



FIG. 3. "CYSTS OF THE PARS PROSTATICA" (BUERGER)

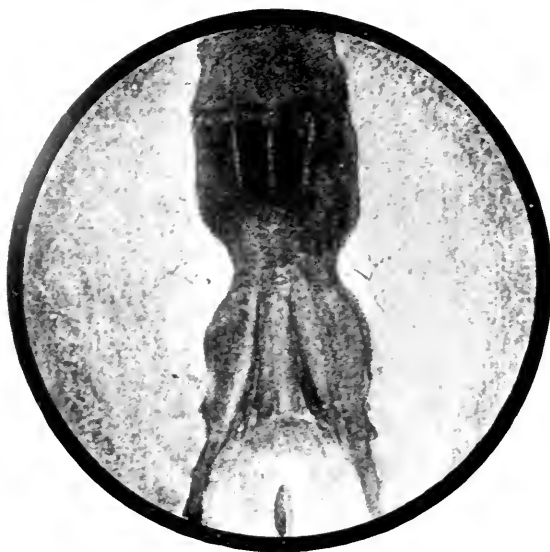


FIG. 4. BEGINNING CYST FORMATION

study suitable sized pieces of tissue from the living with unsatisfactory results owing to the technical difficulties. The impression that these studies of tissue left was that the urethral lesions

*Necropsy findings in twelve cases in which the lympho-cystic urethral lesions were found by Dr. Alexander Randall*

NECROPSY	CLINICAL DIAGNOSIS	GROSS ANATOMICAL DIAGNOSIS	HISTOLOGICAL DIAGNOSIS	CAUSE OF DEATH
E. J. 5463	Miliary tuberculosis (lungs); tuberculous laryngitis	Fibro-purulent tuberculosis of lungs with cavitation; tuberculous ulcerations of intestines	Not given	Chronic pulmonary tuberculosis
P. W. 5454	Pulmonary tuberculosis	Chronic ulcerative tuberculosis of lungs; tuberculous ulcerations of bowel; Miliary, liver and kidneys	Miliary tuberculosis of liver and kidneys	Pulmonary and general miliary tuberculosis
L. L. 5480	Pulmonary tuberculosis	Chronic fibroid tuberculosis of apices, bilateral	Tuberculous pneumonia	Pulmonary tuberculosis and pneumonia
E. McH. 5483	Pulmonary tuberculosis	Chronic diffuse caseous and ulcerous tuberculosis, bilateral; chronic adhesive pleuritis, bilateral; tuberculous peribronchial lymphadenitis	Not given	Pulmonary tuberculosis
R. E. 5492	Osteomyelitis; chronic myocarditis	Bilateral adhesive pleuritis, tuberculous; chronic necrotic endometritis and salpingitis, bilateral; probably tuberculous	Caseous pulmonary tuberculosis	Anteriosclerosis and chronic interstitial nephritis
A. B. 5506	Pulmonary tuberculosis	Chronic bilateral adhesive pleuritis, tuberculous; chronic caseous and ulcerative pulmonary tuberculosis, with cavitation; tuberculous infiltration of liver, perichondritis of larynx, ulceration of ileum, mesenteric and retroperitoneal lymphadenitis	Tuberculosis of lungs, ileum, spleen, etc.	Pulmonary tuberculosis; terminal generalized miliary tuberculosis

C. N. 5552	Pulmonary edema following an emergency tracheotomy for edema of larynx	Early hemorrhagic lobular pneumonia; extreme congestion and edema; tuberculosis of spleen (healed); had been treated for tuberculosis	Not given	Post operative pulmonary edema
C. McM. 5591	Pulmonary tuberculosis	Chronic ulcerative pythiosis; tuberculous lobular pneumonia; tuberculous ulcerative enteritis	Tuberculous pneumonia; miliary tuberculosis of spleen and liver	Chronic ulcerative tuberculosis with toxemia due to secondary infection.
B. C. 5621	Pulmonary tuberculosis	Chronic ulcerative, with superimposed miliary tuberculosis, bilateral; tuberculous peribronchial lymphadenitis; ulcerations of colon and ileum	Miliary tuberculosis of lungs; tuberculous enteritis	Chronic pulmonary tuberculosis
C. W. 5603	Pulmonary tuberculosis	Chronic ulcerative acute miliary pulmonary tuberculosis; ulcerative tuberculous enteritis, amyloid disease	Tuberculous colitis; miliary tuberculosis of spleen and lungs	General tuberculosis
A. W. 5651	Pulmonary tuberculosis	Chronic ulcerative tuberculosis (bilateral); chronic adhesive pleuritis (bilateral)	Caseous and ulcerative pulmonary tuberculosis	Pulmonary tuberculosis
S. V. 5672	Not given	Bilateral apical tuberculosis, healed; chronic interstitial nephritis	Not given	Arteriosclerosis and nephritis

were only occasionally tuberculous but were usually due to the action of some tuberculo-toxin and not the direct implantation of the tubercle bacillus in the mucosa.

My opportunities to obtain specimens at autopsy have been nil but Dr. Alexander Randall has for some time been collecting material at the Philadelphia General Hospital and promises a report upon his findings in the near future. He has very generously given me permission to use the accompanying table of data from the necropsy records of twelve cases showing the urethral lympho-cystic lesions which he has found since the four of his cases cited in my last article upon the subject.

A study of this table will show that all of the patients were definitely tuberculous at death. As the four previously reported were also tuberculous the findings at autopsy were 100 per cent positive.

#### GRAVITY OF THE LOCAL LESION

Observations since my last report have very materially changed my opinion as to the gravity of the local condition. Today I view the lesion important only from a diagnostic standpoint and as an indication of the treatment required, for I have not seen it cause more than local discomfort, usually of a mild type. Just why it is there is not known but its recognition is of the greatest importance from the standpoint of the future health of the patient. It warns one to desist from the prostatic massage that would most likely be carried out and which might be disastrous.

That the lesions bear a definite relation to systemic tuberculosis is shown by the following repeatedly made observations:

1. *They remain or recur as long as the coexisting tuberculous focus remains active in spite of all local treatment to the urethra, including destruction of the cysts.*

2. *In the entire absence of local treatment to the urethra they disappear spontaneously after a more or less prolonged course of anti-tuberculous treatment providing the patient's general health responds.*





FIG. 5. CYSTS NEAR THE VESICAL SPHINCTER



FIG. 6. PROFILE VIEW OF THE CYSTS IN FIGURE 5

They are not an early stage of the classic destructive tuberculous lesions of the urethra that are familiar to us all. The extensive ulcerations, necroses and prostatic excavations of the text-books are things apart from these lympho-cystic lesions and



FIG. 7. TWO LARGE CYSTS OF THE VESICAL SPHINCTER WITH SUPERIMPOSED SMALLER CYST

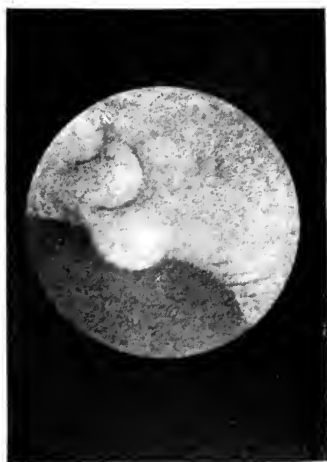


FIG. 8. CYSTS AT AND DISTAL TO THE VESICAL SPHINCTER



FIG. 9. FUSIFORM LESIONS ON THE PROSTATIC DECLIVE



FIG. 10. TWO ELONGATED LESIONS ON THE PROSTATIC DECLIVE

are probably parts of prostatic tuberculosis or due to direct extension from the bladder. Among all the cases I have seen there have been only a few giving even a suspicion of prostatic tuberculosis and the more positive of these had more or less massive tuberculosis in the urogenital tract that in all probability antedated the lesions of the urethral mucous membrane.

The susceptibility of the urethra to the influence of so-called feeding foci in associated mucous surfaces near and remote has figured largely in my efforts to explain the occurrence of the lesions in this locality. Nothing, however, has helped me to really explain the matter and the field for future study upon this phase of the question offers an opportunity for much work.

The early demonstration, either microscopically or by guinea-pig inoculation, of the tubercle bacillus in the urines of many of these patients naturally suggested the kidney as the possible primary urogenital focus. While some of the patients showing massive tuberculosis did have renal tuberculosis, the overwhelming number have presented no demonstrable evidences of renal infection. Often, even with tubercle bacilli present in the urine, it has been impossible to observe any differences in the microscopical characteristics of the urines from the separate kidneys or in their functional activity that would suggest tuberculous renal involvement.

The seminal vesicles were suggested as a possible source but I have been unable to produce any evidence to suggest that this might be the case, there being with one exception, no evidence of an associated tuberculosis of these structures by palpation and I have never been able to demonstrate the tubercle bacillus in the vesicular contents. The preponderance of pulmonary lesions of varying degrees of activity, suggests that the feeding focus is usually pulmonary.

#### SYMPTOMATOLOGY

Burning in the urethra is the most common subjective symptom. This is most often referred to the fossa navicularis but at times is located at the peno-scrotal angle, along the entire urethra, in the perineum, rectum or occasionally at the vesical neck. When in the latter location one generally finds lesions

proximal to the vesical sphincter. While frequency of urination often occurs it is of course more common in these latter cases. Occasionally sexual symptoms, such as premature ejaculations and nocturnal emissions, are found in those patients in whom the prostatic urethra is literally filled with cysts.

The more severe local subjective symptoms are generally due to some massive tuberculosis, either vesical or prostatic, or to a coexisting prostatitis and not directly due to the lymphocystic lesions.

The patients symptomatically are very readily divided into four groups as follows:

*Group 1.* Those patients with a follicular prostatitis, entirely free from subjective symptoms but with a morning discharge and a few shreds in the urine. These cases are discovered only through routine cysto-urethroscopic studies, the necessity for which has often been suggested because the prostatitis has failed to respond to, or has been made worse by treatment. Physical appearance rarely suggests tuberculosis.

*Group 2.* Those patients with or without a previous gonorrhea, in whom there is a slight burning upon urination, a morning discharge and a shreddy urine. The burning suggests the advisability of study and physical appearance only occasionally suggests tuberculosis.

*Group 3.* Those presenting burning at the vesical neck and occasionally in the fossa navicularis, frequency of urination, an anterior discharge and a shreddy urine. Physical appearance quite often suggests the nature of the malady.

*Group 4.* Those presenting any or all of the foregoing symptoms and a turbid urine. The first impression of these patients is that of a well advanced tuberculosis. They are in the minority.

#### IMPORTANCE OF STUDYING CASES OF PROSTATITIS

So commonly have the lesions been discovered in cases being treated for a microscopically proven chronic follicular prostatitis that it would really be good practice to precede every such course of treatment by a cysto-urethroscopy. Certainly it should be a rule to make such a study if after six weeks of such treatment

there is no improvement in the subjective or objective symptoms, particularly if there is even the slightest burning on micturition. Were there no danger of setting up a widespread tuberculosis by massage there is still ample reason for their discovery for an associated prostatitis will not improve while these lesions are in the urethra, whereas, when appropriate systemic treatment has caused their disappearance the prostatitis seems to lend itself very kindly to treatment.

#### TREATMENT

As has been previously hinted the treatment would seem to be that of the coexisting tuberculosis rather than the local lesions and it is certainly best to withhold active treatment of the commonly associated prostatitis until such time as the cysts have disappeared. Early in my studies upon this subject and again recently I have observed patients, in whom a prolonged course of prostatic massage had been carried out, who some months later, showed active lung, kidney or epididymal lesions that were not in evidence at the time of the first study. These may have served to make me ultra-conservative about any local attack on the lesions but my observations extending over the last seven years have convinced me that little if anything is to be gained by destructive methods. It is true that destruction of the cysts seems to temporarily relieve the subjective symptoms in some cases but the oral administration of some palatable form of creosote in sufficient dosage will do the same thing almost invariably. Destruction of the cysts is only followed by their return and it has seemed to me that they are then accompanied by more annoying symptoms than at first.

I can see no harm that would be likely to result from careful instillation of medicaments into the prostatic urethra nor from the careful use of hydrostatic intravesical irrigations, and have therefore made use of these methods where the urethral discharge was a source of much mental anxiety to the patient.

Where sexual symptoms have been pronounced much relief has been obtained from applications of strong silver nitrate solutions to the verumontanum.

It has been my custom to place the patients under the care of an internist with the request that they be placed upon an anti-tuberculous régime. Under this plan the lesions have been seen to disappear in from six months to a year in many of those patients who did not show any very massive tuberculosis at the start. In most cases the obtaining of more rest and the use of tonics has sufficed and it has not been necessary to be very strict with their mode of life.

When the patients are assured that a definite systemic condition exists that makes local treatment inadvisable and that the urethral symptoms are due to that malady and will subside when the general health is improved there is little trouble in keeping them under treatment. A most salutary psychic effect is gained by referring them to an internist as they are thereby convinced that there must be some real reason why the genito-urinary tract should be given a rest from treatment.

The lesions do not in any sense contraindicate renal surgery but have been seen to disappear after the removal of a tuberculous kidney.

#### SUMMARY

1. Of sixteen cases presenting these cysts at autopsy, found by Dr. Randall, all but two showed massive active tuberculosis. One of these had been treated for tuberculosis and showed healed tubercles of the spleen and the other showed old apical lesions. In other words 100 per cent had tuberculosis.

2. 75 living patients, or 83.3 per cent of those in whom careful clinical studies were possible, showed strong evidences of an active tuberculous lesion.

3. In these 75 cases the lesions were (June, 1921) located as follows:

Lungs.....	82.6
Kidneys.....	17.3
Bladder.....	14.6
Epididymis.....	6.6
Prostate.....	8.0
Seminal Vesicles.....	1.3
Peritoneum.....	1.3
Bone.....	2.6
Tubercle bacilli in urine.....	32.0

4. Of the sixteen autopsy cases the principal lesions, exclusive of terminal miliary foci, were distributed as follows,

Lungs.....	93.7
Kidneys.....	12.4
Bladder.....	12.4
Intestines.....	37.5
Pericardium.....	6.2
Liver.....	12.4
Fallopian Tubes.....	6.2
Spleen.....	25.0
Pleura.....	25.0

5. The urethral lesions are important from a diagnostic standpoint alone as they never ulcerate nor extend to the prostate. They remain as long as the causal focus is active, and spontaneously disappear, providing the patient's general health improves.

6. They have absolutely on negative significance as many patients with pulmonary, renal and vesical tuberculosis never have them.

7. They occur in women but are easily confused with the mucosal tabs so common at the female vesical neck.

8. Burning in some portion of the urethra during micturition is the most common subjective symptom. The other symptoms are usually those of a coexisting prostatitis or tuberculous focus.

9. Many patients have symptoms of prostatitis only and are suspected because treatment fails to improve or makes worse the prostatic condition.

10. Approximately 50 per cent of the patients complaining of burning on urination in the absence of acute inflammation and irritating treatment, and 70 per cent of the cases of proven chronic follicular prostatitis that make no improvement or grow worse on massage will show the lesions and have tuberculosis.

11. The lesions are only occasionally true tuberculosis but are apparently due to the action of some tuberculotoxin. They are never primary urogenital tuberculosis.

12. Prostatic massage should be avoided while the lesions are present in the urethra and attention be directed toward rendering latent the causal focus elsewhere in the system. The

burning on urination can usually be relieved by the oral administration of a palatable form of creosote.

13. From the clinical and autopsy data presented it is felt that the association of these lesions with tuberculosis is too frequent to be coincidental and that every patient in whom they exist has a large or small tuberculous focus that is active.

#### CASE HISTORIES AND CLINICO-LABORATORY FINDINGS

The appended brief case histories, from which the irrelevant points have been deleted are those of seventy-five patients presenting the urethral lesions who showed clinical or laboratory evidences of tuberculosis.

The cystoscopic and most of the urinary findings are my own and the *other data are those of colleagues to whom credit is given* and to whom I owe a debt of thanks for their kind coöperation in these studies.

##### *Case 1. B. D., 1914.*

Family history: Negative.

Past history: Had had "pulmonary trouble" for two years.

Present illness: Was being treated at the Jefferson Medical College Department for Tuberculosis for *extensive bilateral pulmonary tuberculosis*. For several months he had complained of constant burning pain at the vesical neck, ardor urinae and a nocturia of three times.

Cystoscopy 1914: Bladder and ureteral orifices were normal. Posterior urethra showed many lympho-cystic bodies.

Cystoscopy 1915: Bladder normal. Left ureteral orifice looked suspicious of tuberculosis. Posterior urethra contained many large cystic bodies.

Urine: Catheterized from left kidney contained much pus and *many tubercle bacilli*.

Prostate: Normal to palpation but its secretion contained pus.

##### *Case 2. T. S., 1914.*

Family history: Negative.

Past history: For fifteen years had had nocturia of from one to four times. For nine years had burning pain at the vesical neck. Seven years ago had a *tuberculous right kidney* removed. One year ago had a *left perinephritic abscess opened and drained* and again two months ago.



Present illness: Emaciated, anemic, and had burning pain at the vesical neck, nocturia and a discharging sinus in the left loin.

Cystoscopy: Bladder normal. Right ureteral orifice could not be seen; left was normal. Posterior urethral walls covered with lympho-cystic bodies.

Urine: Perfectly clear and negative for pus and tubercle bacilli.

Prostate: Chronic follicular prostatitis.

Note: 1915. There was an *advanced pulmonary tuberculosis* and a freely discharging *tuberculous sinus* in the left loin.

*Case 3.* N. M., age twenty-three years, May 8, 1914.

Family history: Father died of tuberculosis and patient lived with tuberculous mother-in-law.

Past history: Unimportant.

Present illness: For the last eight months he had had a burning pain at the vesical neck and, upon voiding, in the anterior urethra and a nocturia of from three to five times.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra contained lympho-cystic lesions and a small ulceration.

Prostate: Follicular inflammation.

Urine: *Tubercle bacilli present.*

*Case 4.* J. D., 1914.

Family history: Negative.

Past history: No previous urological complaints.

Present illness: For the last two months he had had slight burning at the vesical neck, ardor urinae and nocturia of two times.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra showed a few cystic bodies.

Prostate: Chronic follicular inflammation.

Chest: "*Active tuberculosis of both upper pulmonary lobes.*" (Jefferson Medical Dispensary.)

*Case 5.* J. B., 1914.

Family history: Negative.

Past history: Gonorrhea fifteen months ago.

Present illness: Morning discharge, burning pain at the vesical neck and ardor urinae.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra thickly studded with cysts of all types.

Prostate: Chronic follicular inflammation.

Urine: Shreddy but negative to tubercle bacilli.

Tissue: Section of tissue removed from the posterior urethra showed "*Tuberculosis and tubercle bacilli are easily demonstrated in it.*" (Rosenberger.)

Note: 1915, Patient had lost greatly in weight and had "*active pulmonary tuberculosis.*" (Jefferson Medical Dispensary.)

Cystoscopy: Practically as before.

Case 6. R. C., 1914.

Family history: Negative.

Past history: Gonorrhea three years before.

Present illness: For several months he had had constant burning pain at the vesical neck, burning on urination in the anterior urethra and a morning discharge.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra contained the lympho-cystic bodies.

Prostate: Chronic follicular prostatitis.

Urine: Shreddy and contained *tubercle bacilli*.

Case 7. A. McC., 1914.

Family history: Negative.

Past history: Gonorrhea one year ago.

Present illness: Felt that his gonorrhea had never been cured as he he still had a morning discharge and a shreddy urine. No subjective symptoms.

Cystoscopy: Bladder and ureteral orifices normal. Many lympho-cystic lesions in the posterior urethra.

Prostate: Secretion almost pure pus.

Urine: *Many tubercle bacilli present.*

Cystoscopy: Three months later the condition was unchanged.

Note: In the three months elapsing between the above studies the patient received prostatic massage in a dispensary after which he showed a *tuberculous right vas deferens and epididymis*.

Six months later this patient showed a more pronounced involvement of his epididymis and an "*active pulmonary tuberculosis.*" (Jefferson Medical Dispensary.)

Case 8. R. W., age 22 years, September 23, 1915.

Family history: Negative.

Past history: Scarlet fever at five years with persisting discharge from ear.

Present illness: Burning upon urination and shreddy urine. Pain in right lower chest anteriorly on deep breathing.

Cystoscopy: Bladder and left ureteral orifice normal. Right ureteral orifice inflamed. Posterior urethra showed many lympho-cystic lesions. Phthalein returns from separate kidneys were equal.

Prostate: Chronic follicular prostatitis.

Chest: "*Friction rub in the right chest and clinical evidences of active pulmonary tuberculosis.*" (Jefferson Medical Dispensary.)

*Case 9.* J. M., age seventeen years, October, 1915.

Family history: Negative.

Past history: Four months ago noticed a burning pain in the glans on urination and a nocturia of from eight to fifteen times. Later this burning became worse after urination. One month ago he had an attack of right renal colic lasting about half an hour and relieved by the passage of a large blood-streaked yellow plug, followed by a quantity of blood. Several such attacks had occurred since.

Present illness: Frequent urination with great burning along the urethra during the act.

Cystoscopy: The right ureteral orifice was greatly pouted and surrounded by an area of *tuberculous infiltration* extending across the trigone and up on the left wall of the bladder. Cloudy urine was seen coming from the right ureteral orifice and clear from the left. The posterior urethra was full of lympho-cystic bodies. A half hour intravenous phthalein test showed from the right kidney 15 per cent and the left 33 per cent return.

Urine: The right kidney urine was full of pus and showed countless *tubercle bacilli*; the left was normal.

Operation: On December 2, 1915 *the right kidney was removed and its upper half was practically destroyed by tuberculosis.*

Note: A cystoscopy four months later revealed a practically normal bladder and an entire disappearance of the urethral lesions.

*Case 10.* E. H., age twenty-six years, 1916.

Family history: Negative.

Past history: At the age of eight he was said to have a "very suspicious spot on the lung." Had rheumatic fever in 1905 and gonorrhea in 1911. Since his attack of gonorrhea he had been persistently

treated for chronic posterior urethritis on account of morning discharge and shreddy urine.

Present illness: Slight burning pain in the perineum, ardor urinae, glueing of the urinary meatus and sharp pain in glans during erection.

Cystoscopy: Bladder and ureteral orifices normal. Many lympho-cystic lesions in the posterior urethra.

Urine: *Tubercle bacilli present.*

Tissue: Section from the mucosa of the posterior urethra was pronounced "*typical tuberculous tissue.*" (Rosenberger.)

Chest: "*Has evidently had quite an extensive pulmonary tuberculous lesion which seems to be latent at the present time.*" (Beardsley.)

*Case 11.* B. B., age forty years, August, 1916.

Family history: Negative.

Past history: Said he had always been well.

Present illness: For some weeks he had experienced excessive perspiration on the slightest exertion. Had lost his sexual power, was very nervous and had frequent nocturnal emissions.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra literally filled with cysts.

Prostate: Chronic follicular prostatitis.

Chest: "*Breath sounds poor throughout. Friction bases anteriorly and right posteriorly where there is a bulging. Chronic pulmonary tuberculosis.*" (Jefferson Medical Dispensary.)

Urine: *Many tubercle bacilli present.*

Cystoscopy: October 15, 1916. Bladder normal. Both ureteral orifices inflamed. Neither ureter could be catheterized. Urethra as before.

*Case 12.* O. C., age thirty - nine years, November 17, 1916.

Family history: Negative.

Past history: Had a *pulmonary hemorrhage* six year ago. Gonorrhea three years ago. Had lost nineteen pounds in the last year.

Present illness: Nocturia of three times and shreds in the urine.

Cystoscopy: Bladder and left ureteral orifice normal. Right ureteral orifice slightly reddened. Posterior urethra showed lympho-cystic bodies. There were several strictures of large calibre of the anterior urethra.

Prostate: Chronic follicular prostatitis.

Chest: "I examined O. C. today. He has definite physical signs of involvement of the right upper lobe which, in my opinion, spells *Pulmonary tuberculosis*." (Beardsley.)

*Case 13.* Mr. J., December, 1915.

Family history: Negative.

Past history: Had lues eleven years ago with negative Wassermann for the last two years. Gonorrhea seven years ago with shreddy urine and morning discharge since.

Present illness: Five weeks ago he developed a profuse discharge, ten days after a sexual exposure. Smears were constantly negative for gonococci. There was a burning, frequency and a cloudy urine, which symptoms gradually subsided.

Cystoscopy: Bladder and right ureteral orifice normal. Left ureteral orifice reddened. Many cysts in the posterior urethra.

Urine: *Many tubercle bacilli present.*

*Case 14.* D. S., age twenty-eight years, 1917.

Family history: Negative.

Past history: Gonorrhea three years ago.

Present illness: Slight anterior discharge and shreddy urine.

Cystoscopy: Bladder and right ureteral orifice normal. Left ureteral orifice reddened. Lympho-cystic bodies in the posterior urethra. Phthalein outputs of the two kidneys were equal and there was no pus in either kidney urine.

Prostate: Chronic follicular prostatitis.

Chest: "*An apparently inactive lesion of the right lung posteriorly.*" (Clapp.)

Urine: *Tubercle bacilli in the twenty-four hour specimen.*

Chest: *Six months later.* "*Shows a marked active lesion in the upper right lobe.*" (Clapp.)

*Case 15.* S. H., age twenty-five years, 1916.

Family history: One brother with cervical adenitis.

Past history: Typhoid eight years ago. Gonorrhea two years ago and again one year ago.

Present illness: Had had a cough for some weeks, a morning discharge and burning in the fossa navicularia on urination. Shreddy urine.

Cystoscopy: Bladder and left ureteral orifice normal. Right ureteral orifice reddened. Posterior urethra showed many lympho-cystic bodies. Separate phthalein test showed the outputs of the kidneys equal.

Prostate: Chronic follicular prostatitis.

Chest: "*Active lesion of the apex of the lung.*" (Jefferson Medical Dispensary.)

Urine: *Tubercle bacilli present.*

*Case 16.* M. O'S., age twenty-four years, November 23, 1916.

Family history: Negative.

Past history: Gonorrhea three years ago, with epididymitis.  
Gonorrhea again six months ago.

Present illness: Felt that he had not been cured of his first attack of gonorrhea as shreds had always been present in the urine. Nocturnal frequency two to three times and a diurnal of every hour. Pain at the vesical neck and in the fossa navicularis and burning in the latter location on voiding. Slight pain over the right kidney and cough for two months.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra is very shreddy, with denuded areas on both lateral walls and a number of cystic bodies. Several large prostatic openings present.

Prostate: Chronic prostatitis.

Chest: "*Active pulmonary tuberculosis.*" (Beardsley and Clapp.)

Urine: *Tubercle bacilli present.*

*Case 17.* I. M. H., age twenty-seven years, 1916.

Family history: Negative.

Past history: Unimportant.

Present illness: For the last five years had had nocturia of one to two times. One year ago noticed burning in penile urethra after urination, and pyuria.

Cystoscopy: Bladder and right ureteral orifice normal. Left ureteral orifice reddened. Trigone was dusky and slightly edematous near the vesical outlet. Posterior urethra contained many cysts. Separate kidney outputs of phthalein were practically equal for both sides.

Prostate: Was *enlarged, nodular* and its secretion contained many pus cells.

Chest: Negative.

Urine: *Showed much pus and many tubercle bacilli.*

*Case 18.* H. G., age twenty-four years, November, 1916.

Family history: Negative.

Past history: Gonorrhea and chancre four years ago.

Present illness: Morning discharge, burning at the vesical neck and, upon voiding, in the fossa navicularis. Wassermann positive.

Cystoscopy: Bladder and left ureteral orifice normal. Right ureteral orifice reddened. The posterior urethra showed many lympho-cystic bodies.

Prostate: Chronic follicular prostatitis. *Two round pea-sized nodules in the lower part of the left spermatic cord.*

Chest: *"Surely a lesion in the upper left lobe, moisture, râles impairment and cough."* (Beardsley and Clapp.)

*Case 19.* H. S., age twenty-three years, 1916.

Family history: Negative.

Past history: Treated in Jefferson Hospital in 1915 for incipient *pulmonary tuberculosis*, and phosphaturia. At this time he had had frequent and burning urination for five years, cough and some dyspnoea for six months and had lost twenty-five pounds in weight. There was a positive Von Pirquet, a negative Wassermann and a positive chest x-ray.

Present illness: Nocturnal and diurnal frequency. Constant burning at the vesical outlet and, during urination, along the entire urethra. Urethral discharge, phosphaturia, pyuria and occasional dull pain in both renal regions.

Cystoscopy: Bladder inflamed and both ureteral areas were highly suspicious of tuberculosis. Posterior urethra showed many lympho-cystic bodies.

Catheterized urines from both kidneys showed much pus, large, amounts of amorphous phosphates and great clumps of staphylococci but no tubercle bacilli. The phthalein outputs were equal.

Prostate: Chronic follicular prostatitis.

Chest: *"Tuberculous infiltration and some fibroid changes in the right upper lobe and tuberculous infiltration of the apex of the right lower lobe and of the apex of the left upper lobe."* (Lawrence Flick.)

Note: January 1920. *The patient was experiencing an acute exacerbation of his old pulmonary tuberculosis with cough, night-sweats and fever.*

*Case 20.* W. H. W., age twenty-three years, 1917.

Family history: Negative.

Past history: Influenza in winter of 1914-15. Two years ago he noticed a cloudy urine and a diagnosis of colon bacillus pyelitis was made. For this he was given a vaccine from which he experienced such a profound reaction that it took him several months to regain his strength.

Present illness: Marked pyuria.

Cystoscopy: Bladder and left ureteral orifice normal. Right orifice inflamed. The trigone was inflamed and exhibited several small *tuberculous granulomata* on its right side. The posterior urethra contained a few cystic bodies.

The right renal function was about half that of the left.

Chest: *Pulmonary tuberculosis*. (H. A. Hare.) *X-ray positive for tuberculosis*. (Manges.)

Urine: Contained pus and *tubercle bacilli*.

*Case 21.* S. B., age thirty-four years, November, 1917.

Family history: Negative.

Past history At age of ten, after an injury, he developed a marked *kyphosis and lordosis*. Six years ago he had a *discharging scrotal sinus*. Had never had any venereal disease.

Present illness: For the last ten months he had had ardor urinae and a frequency of every hour day and night. Emaciated. Urine highly suggestive of tuberculosis.

Cystoscopy: Bladder was markedly contracted and showed a *general tuberculous infiltration*. Neither ureteral orifice could be seen. The posterior urethra was almost filled with the lympho-cystic lesions.

Prostate: *Evidently tuberculous* and there was marked *tuberculosis of both epididymi*.

Urine: Shows a large amount of pus and a *great number of tubercle bacilli*.

July 1, 1921. *Contracted tuberculous bladder with probable bilateral renal tuberculosis*.

*Case 22.* J. F. B., age thirty-five years, 1917.

Family history: Wife and three daughters died of tuberculosis.

Past history: Burning in the fossa navicularis on urination for six years. Had passed several small stones at different times. Pyuria and diurnal frequency for three years.

Present illness: For the last year had had pain in the right renal region. Burning at the vesical outlet, urgency, frequency and pyuria.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra showed a number of cystic bodies.

Both kidney urines showed many pus cells and immense clumps of staphylococci but no tubercle bacilli.

Chest: "*Chronic pulmonary tuberculosis*." (Beardsley.)



*Case 23.* H. N., age forty-five years, 1917.

Family history: Sister died of tuberculosis.

Past history: Left-sided pleurisy in 1912 followed by night-sweats.

Present illness: For the last eighteen months had had attacks of right renal colic.

Cystoscopy: Bladder and ureteral orifices normal. Lympho-cystic bodies in the posterior urethra.

Chest: "*Chronic pulmonary tuberculosis.*" (Beardsley.)

*Case 24.* D. M., age twenty-five years, 1917.

Family history: Negative.

Past history: Gonorrhea two years ago. Cough and blood-spitting two months ago.

Present illness: Constant burning in the urethra, morning discharge and shreddy urine.

Cystoscopy: Bladder and right ureteral orifice normal. Left ureteral orifice slightly tumid. The posterior urethra showed many lympho-cystic bodies.

Prostate: Chronic prostatitis.

Chest: "*There is an undoubted tuberculous lesion of the apex of the right lung.*" (Jefferson Medical Dispensary.)

*Case 25.* Mrs. W.

Family history: Negative.

Past history: Had had a plastic operation upon the pelvic organs several years before for the relief of burning and frequency.

Present illness: Marked frequency and intense burning on urination.

Cystoscopy: Bladder normal. Both ureteral areas were tuberculous. The anterior trigonal angle and entire urethra were filled with the lympho-cystic bodies.

Catheterized urines from both kidneys showed pus and *large numbers of tubercle bacilli.*

*Case 26.* P. C., age thirty-seven years, August, 1916.

Family history: Negative.

Past history: Gonorrhea five years ago for which he was still being treated.

Present illness: Impotence, anterior discharge, nocturia of two times, pain in lumbar region, burning pain at the vesical neck and ardor urinae. Had lost 10 pounds in weight.

Cystoscopy: Bladder and ureteral orifices normal. Many cysts at the vesical sphincter and in the posterior urethra.

Prostate: Chronic prostatitis.

Chest: "*Distinct evidences of chronic tuberculosis infiltration in the right upper lobe.*" (Jefferson Medical Dispensary.)

"*Pulmonary tuberculosis.*" (Brinton.)

Case 27. M. Z., age thirty-eight years, February 6, 1917.

Family history: Negative.

Past history: Three months ago had four stones removed from his bladder suprapubically.

Present illness: Burning, frequency and pyuria.

Cystoscopy: The bladder was inflamed, with a mild grade of edema over the entire trigone. There was a broad median prostatic bar but no lateral lobe enlargement and the posterior urethra exhibited many of the lympho-cystic bodies.

Chest: "*Chronic pulmonary tuberculosis.*" (Jefferson Medical Dispensary.)

Prostate: Secretion showed much pus.

Urine: Contained much pus and *many tubercle bacilli*.

Case 28. R. A. S., age twenty-five years, 1916.

Family history: Negative.

Past history: Had marasmus until three years of age. Gonorrhea two and a half years ago.

Present illness: Anterior discharge for the last two years. Burning in the fossa navicularis and perineum. Shreddy urine.

Cystoscopy: Bladder normal. Ureteral orifices slightly reddened. Posterior urethra contained a number of cysts.

Prostate: Chronic prostatitis.

Chest: "*There is an old lesion of the upper lobe of the right lung which seems to have taken on a mild grade of activity.*" (Beardsley.)

Case 29. L. B. J., age thirty years, February, 1917.

Family history: Negative.

Past history: Several attacks of gonorrhea prior to ten years ago

In an examination for the navy five years ago he was rejected for a lung lesion.

Present illness: For the last two months he had had slight irritability at the vesical neck with some burning in the fossa navicularis, frequency and pyuria.

Cystoscopy: Bladder normal. Right ureteral orifice edematous and there was an area of *tuberculous edema* extending from it to the vesical outlet. The entire posterior urethra was practically covered with the lympho-cystic bodies.

Prostate: Chronic follicular prostatitis.

Chest: "*The upper lobes of both lungs show distinct evidence of tuberculous infiltration which seems to be latent at the present time.*" (Beardsley.)

Urine: Loaded with pus and *tubercle bacilli*.

Case 30. A. N., age fifty-two years, February 23, 1917.

Family history: Negative.

Past history: Many cervical abscesses in childhood. Typhoid twenty-four years ago. "Kidney trouble" four years ago. *Abscesses of the right scrotum* four years ago which were opened and drained. Denied venereal infection.

Present illness: For two months he had had a frequency of every hour, pain at the vesical neck, ardor urinae, night-sweats and pyuria.

Cystoscopy: *Tuberculous infiltration of the bladder, which was most marked at the left ureteral area*, and a number of lympho-cystic lesions in the posterior urethra.

Epididymi: *Both markedly tuberculous*.

Urine: Contained pus and *tubercle bacilli*.

Case 31. J. R., age thirty-five years, February 20, 1917.

Family history: Negative.

Past history: Gonorrhea two years ago. Epididymitis six months ago.

Present illness: Burning pain in the perineum before urination. Shreddy urine.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra showed a few cysts.

Prostate: Chronic prostatitis.

Chest: "*It is perfectly evident that this man has a tuberculous lesion in his lung.*" (Jefferson Medical Dispensary.)

Case 32. J. W., age twenty-four years, February 26, 1917.

Family history: Negative.

Past history: Gonorrhea seven and four years ago. Morning discharge and shreddy urine for last three years.

Present illness: Four weeks ago he noticed burning pain in the fossa navicularis on urination. Discharge at the meatus and shreddy urine. Cough for the last three months and had lost 6 pounds in the last month.

Cystoscopy: Bladder normal. Trigone and ureteral areas were inflamed and tumid. The posterior urethra exhibited several cysts, its entire mucosa looked unhealthy and there were several small ulcerations upon it.

Prostate: Chronic follicular prostatitis.

Chest: "*This boy has a chronic lesion in his lung. He also has an acute lesion and should be at rest in bed.*" (Jefferson Medical Dispensary.)

*Case 33.* C. R., age twenty-two years, February 26, 1917.

Family history: Negative.

Past history: Gonorrhea two and one years ago.

Present illness: Since his last attack of gonorrhea he had had burning pain in the fossa navicularis, a urethral discharge and a nocturia of from one to three times. He had lost seventeen pounds and for three weeks had had a cough.

Cystoscopy: Bladder and ureteral orifices normal and the posterior urethra contained many lympho-cystic bodies.

Prostate: Chronic prostatitis.

Chest: "*This boy shows an absolutely positive lesion in the right upper lobe. He should be sent to the State Dispensary.*" (Beardsley.)

*Case 34.* H. M., age thirty years, February 26, 1917.

Family history: Negative.

Past history. Gonorrhea thirteen years ago and again three years ago.

Present illness: Since his last gonorrhea he had had a morning discharge, shreds in his urine and occasional burning in the fossa navicularis on urination.

Cystoscopy: Bladder and ureteral orifices normal. Many cysts in the posterior urethra.

Prostate: Chronic prostatitis.

Chest: "*Undoubted evidences of pulmonary tuberculosis in both upper lobes that is very mildly active.*" (Jefferson Medical Dispensary.)

*Case 35.* E. H., age twenty-six years, 1917.

Family history: Negative.

Past history: Fractured thigh ten years ago. Five years ago he began to have pain in the rectum which was relieved by emptying the bladder. This pain became so severe that he was unable to work during the last year. There was also a lancinating pain in the rectum at the culmination of the sexual act.

Present illness: Continuation of the above symptoms with great frequency, burning in the urethra and a marked pyuria.

Cystoscopy: *The entire base of the bladder was covered with typical tuberculous edema.* Neither ureteral orifice could be seen and the posterior urethra showed a number of the lympho-cystic bodies.

Prostate: *Large, nodular and evidently tuberculous.*

Chest: *Chronic pulmonary tuberculous infiltration as low down as the fifth rib on one side.*" (Beardsley.)

Case 36. M. L., age thirty-six years, September, 1916.

Family history: Negative.

Past history: Two years ago he had had a small vesical papilloma removed by fulguration. Six months ago he had hematuria.

Present illness: Since his hematuria he had had burning in the fossa navicularis on urination, frequency, great loss in weight, marked physical weakness, cough, nervousness and "stomach trouble." For the last two months he had had *cough, night-sweats and fever.*

Cystoscopy: The bladder and ureteral orifices normal and showed no recurrence of his papilloma. The posterior urethra was practically filled with the lympho-cystic lesions.

Note: Further study of this case was not possible but inquiry has elicited the fact that he died a year later of "nervousness and indigestion."

Case 37. J. F. B., age twenty-three years, 1916.

Family history: Negative.

Past history: Gonorrhea three years and one year ago. Cough lasting several months during the previous winter.

Present illness: Had distress in the left chest for six weeks. Morning discharge and pyuria. Had lost much weight.

Cystoscopy: Bladder and ureteral orifices normal and the posterior urethra showed many lympho-cystic bodies.

Prostate: Chronic prostatitis.

Chest: *There is what is probably a tuberculous pleurisy at the base of the left lung and râles and impaired resonance in its upper lobe.*" (Jefferson Medical Dispensary.)

*Case 38. Miss R., 1914.*

Family history: Negative.

Past history: Negative.

Present illness: For several months had had intense burning on urination, marked tenesmus and frequency.

Cystoscopy: Bladder and ureteral orifices normal. Anterior trigonal angle, vesical outlet and entire urethra covered with cysts.

Note: This being one of the very early cases seen the cysts were destroyed by fulguration under the impression that they were new growths.

1915: Patient was placed in a sanitarium for the treatment of an *acute pulmonary tuberculosis*.

1920: *At this writing the patient had an extensive bilateral pulmonary tuberculosis and was doing very poorly.*

*Case 39. M. R., age fifty-four years. 1916.*

Family history: Negative.

Past history: At twenty-two he had a number of *pulmonary hemorrhages* and was sent to Adirondacks by Dr. Loomis of New York. Gonorrhea twenty years ago and had had trouble in his prostate ever since.

Present illness: Had pain in the prostatic region during intercourse, burning along the urethra and a shreddy urine.

Cystoscopy: Bladder and ureteral orifices were normal. The posterior urethra showed many lympho-cystic bodies.

Prostate: Slightly nodular and its secretion contained much pus.

Note: December 10, 1917. The pain was still present upon coition and occasionally at stool.

Cystoscopy: Bladder and ureteral orifices normal. The trigone and vesical outlet were injected. The lateral prostatic lobes pushed in toward the urethral lumen with marked irregularity, there were a number of lympho-cystic excrescences and there was what appeared to be a sloughing area in the right prostatic sulcus.

Prostate: Was nodular and tender, *apparently tuberculous*.

*Case 40. E. P. H., 1917.*

Family history: Negative.

Past history: Gonorrhea nine years ago. One year ago had pain in the umbilical region lasting for five months.

Present illness: Had had a cough for six months. Two months ago he developed a burning pain over the bladder region, dragging pain in

the testicles, burning in the sacral region, nocturia of two or three times, and a pain along the urethra on voiding.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra showed a cluster of cysts.

Prostate: Chronic follicular prostatitis.

Chest: "*Definite lesion in the right lung, probably tuberculous.*" (Jefferson Medical Dispensary.)

*Case 41.* E. W. M., age twenty-one years. March 1, 1919.

Family history: Negative.

Past history: Gonorrhea in March 1918.

Present illness: Since the preceding July he had had a morning discharge, discomfort at the vesical sphincter and burning in the fossa navicularis.

Cystoscopy: There was a mild basal cystitis and the posterior urethra showed many large cysts.

Prostate: Chronic prostatitis.

Chest: "*Early pulmonary tuberculosis.*" (Clapp.)

*Case 42.* A. H., age twenty-seven years. March 5, 1917.

Family history: Negative.

Past history: Chancre in 1915 and had been intensively treated for lues with a negative Wassermann since July, 1915. Gonorrhea nine years, three years and again three months ago.

Present illness: Morning discharge, burning in the anterior urethra and pyuria.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra showed many lympho-cystic lesions and a large, scarred prostatic opening.

Prostate: Secretion almost pure pus.

Chest: "*Old tuberculous lesion in both upper lobes, now mildly active.*" (Jefferson Medical Dispensary.)

Note: Jan. 1920. In excellent general health but prostatitis was still present. The urethral lesions had entirely disappeared.

*Case 43.* H. N., age twenty-four years, June, 1917.

Family history: Negative.

Past history: Unimportant.

Present illness: Burning and frequency for three months. "Enlarged testicles."

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethral mucosa covered with lympho-cystic bodies.

Prostate: *Nodular and probably tuberculous. Tuberculous left epididymis with enlargement of the testicle.*

Chest: "*Old lesion in the right upper lobe and a right basal pleurisy.*" (Jefferson Medical Dispensary.)

*Case 44.* C. De V., age twenty-five years, 1917.

Family history: Negative.

Past history: Gonorrhea January, 1916.

Present illness: Morning discharge, frequency, burning in the fossa navicularis and shreddy urine.

Cystoscopy: Bladder and right ureteral orifice normal. Left ureteral orifice was dilated but not inflamed. The posterior urethra showed several cysts.

Prostate: Chronic follicular prostatitis.

Chest: "*Tuberculosis of both upper lobes.*" (Jefferson Medical Dispensary.) *Confirmed by x-ray.* (Manges.)

*Case 45.* A. H., age twenty-five years.

Family history: Negative.

Past history: Gonorrhea with right epididymitis four years before.

Present illness: Morning discharge, irritation at the vesical outlet and shreds in the urine.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra showed many lympho-cystic lesions.

Prostate: Chronic follicular prostatitis.

Chest: "*Shows an old tuberculous lesion.*" (Beardsley.)

*Case 46.* S. C., age twenty-six years.

Family history: Negative.

Past history: Gonorrhea two years ago.

Present illness: Burning along the urethra on urination, morning discharge, shreddy urine and loss of fifteen pounds in weight.

Cystoscopy: Bladder and ureteral orifices normal and the posterior urethra showed the lympho-cystic lesions.

Chest: "Negative to clinical examination."

X-ray: "*Great shadows in the area of the peribronchial glands and several suspicious looking areas in the apex.*" (Manges.)

Note: After a year's out-door life the urethral lesions had disappeared and he had regained his weight.



*Case 47.* B. W., age thirty years, 1918.

Family history: Negative.

Past history: Gonorrhea with epididymitis twelve years ago. Grippe one year ago.

Present illness: Since his attack of grippe he had had pain over both lungs, posteriorly, diurnal frequency of ten times and shreddy urine.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra contained a number of cysts.

Prostate: Chronic prostatitis.

Chest: "*Old tuberculous lesion at right apex to third rib, apparently quiescent.*" (University Hospital Medical Dispensary.)

*Case 48.* F. A. S., age twenty-nine years, October 18, 1917.

Family history: Negative.

Past history: Had had a *cold abscess* opened in the left inguinal region at eleven years. At eighteen years he had *tuberculosis of the spine* and at twenty-four had a bone transplant made. Gonorrhea one year ago.

Present illness: Had pain in the right renal region for the last three years which had become severe. For weeks he had had a cloudy urine. Urethral stricture of large calibre. Pyuria.

Cystoscopy: Bladder and ureteral orifices normal and the posterior urethra contained many cysts.

Prostate: Chronic follicular prostatitis.

Urine: Loaded with pus and *tubercle bacilli*. *Left kidney urine contained pus and tubercle bacilli.*

Phthalein returns from separate kidneys (one-half hour intravenous) right 5 per cent and left 26 per cent.

Operation: *Right nephrectomy, kidney almost destroyed by tuberculosis.*

*Case 49.* H. G. A. S., age twenty-eight years, 1918.

Family history: Negative.

Past history: Between the ages of seven and fifteen years he had had to spend his winters in Florida to avoid bronchitis and asthma. Ten years ago he had gonorrhea. *Two years ago he had tubercle bacilli in his sputum and blood-spitting* and was given tuberculin treatment by Dr. Frank Billings of Chicago. For nine years he had had a morning discharge at the meatus and a shreddy urine.

Present illness: Morning discharge, shreddy urine and burning along the urethra.

Cystoscopy: Bladder and ureteral orifices normal and the posterior urethra showed several cystic bodies.

Prostate: Chronic prostatitis.

Chest: "*Pulmonary tuberculosis, bilateral.*" (McCarthy.)

*Case 50.* A. M. T., age forty-five years, March 26, 1918.

Family history: Negative.

Past history: For twenty-five years he had had pain in the perineum on sitting and a feeling of a heavy weight there upon standing. Ten years ago he had a cystitis and an acute urinary retention for which he was catheterized. About this time he was cystoscoped twice to exclude vesical calculus. For months prior to a year ago he had been given prostatic massage which made him worse.

Present illness: Seven weeks ago he had an acute retention for which he was catheterized. This was followed by epididymitis. Since his massage he had had a burning pain "between the bladder and rectum" that was so severe he was unable to work. This pain was increased by any sudden jar and he had to sit on an air cushion. Nocturia of two to ten times.

Cystoscopy: Bladder was inflamed and trabeculated. The vesical neck was greatly pushed up by the underlying prostatic commissure. The posterior urethra showed several lympho-cystic lesions, *many large scarred prostatic openings and a number of typical tubercles.*

Prostate: Large, soft, tender and had a small nodule in its right side.

Urine: *Tubercle bacilli present.*

Note: In July, 1919, he was in the hospital under the care of Dr. J. Chalmers Da Costa for *tuberculous peritonitis* and was in a very poor physical condition.

*Case 51.* C. J., age twenty years, August 2, 1918.

Family history: Negative.

Past history: Had lues in 1916 for which he was given intensive treatment, followed by several negative Wassermann tests. Gonorrhea two and a half years ago.

Present illness: Had lost fifteen pounds in the last six months and was having frequent nocturnal emissions.

Cystoscopy: Bladder and ureteral orifices normal. The posterior urethra was literally filled with lympho-cystic lesions.

Prostate: Chronic prostatitis.

Chest: "*Active pulmonary tuberculosis.*" (Nofer.)

Note: January 4, 1919, this patient had gained nineteen pounds and his cystoscopic picture was unchanged.

*Case 52.* A. S., age eighteen years, January 14, 1919.

Family history: Negative.

Past history: Had had *tuberculous adenitis* in 1913 and bilateral herniotomy in 1914. The herinae recurred and were again operated upon three months before study.

Present illness: Had pain in the renal regions when he urinated and burning in the urethra. One and a half ounces of apparent residual urine.

Cystoscopy: Bladder of great capacity and showed a mild grade of inflammation. Both ureteral orifices were very large and were not occluded by a no. 11 F. catheter. The urine emitted from the catheter by a steady dripping on each side. There was no vesical neck obstruction and the residual urine was evidently from his dilated ureters. The posterior urethra showed many cysts.

Half hour separate phthalein returns from each kidney were too small to estimate.

Urine: Showed much pus and many *tubercle bacilli* and staphylococci.

Cystoscopy: December 16, 1919. The bladder showed a number of *typical tubercles* on its left posterior wall. The ureteral orifices were larger than before but the urethral picture was unchanged.

*Case 53.* J. M. S., age twenty-six years, February 6, 1919.

Family history: Negative.

Past history: Gonorrhea seven months ago. Discharged from the United States Army for *pulmonary tuberculosis*. After this was given prostatic massage though he complained continually of pain at the vesical neck and burning on urination.

Present illness: Morning discharge, burning on urination and nocturia.

Cystoscopy: Bladder and ureteral orifices normal. The posterior urethra was filled with the lympho-cystic bodies.

Prostate: Chronic follicular prostatitis.

Chest: "*Active pulmonary tuberculosis.*" (Craig.)

*Case 54.* H. L. C., age thirty-two years, March 18, 1918.

Family history: Sister and maternal uncle and aunt died of tuberculosis.

Past history: Gonorrhea with bilateral epididymitis one year before. Aspermia.

Present illness: Burning pain at the peno-scrotal angle, morning discharge and cloudy urine.

Cystoscopy: Bladder and ureteral orifices normal, with many lymphocystic bodies in the posterior urethra.

Chest: "*Pulmonary tuberculosis.*" (Torrey.)

*Case 55.* R. B., age twenty-one years, December 5, 1919.

Family history: Negative.

Past history: Gonorrhea two years ago and again one year ago.

Present illness: Urethral discharge, burning on urination and a shreddy urine.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra showed the lympho-cystic lesions and one large prostatic opening.

Prostate: Chronic prostatitis.

Chest: "*Suspicious area in the left apex.*" (University Hospital Medical Dispensary.)

X-ray: "*Left apex slightly suspicious. Right apex, 1st interspace, very suspicious and looks like pulmonary tuberculosis.*" (Pancoast.)

*Case 56.* P. M., age nineteen years, December 4, 1917.

Family history: Father died of tuberculosis.

Past history: Unimportant.

Present illness: Pain at the peno-scrotal angle on voiding for the last month and pyuria.

Cystoscopy: Bladder and ureteral orifices normal. The posterior urethra showed a number of cysts and large prostatic openings.

Prostate: Chronic prostatitis.

Urine: Bilateral pyuria with many staphylococci. Separate phthalin functions were equal. The twenty-four hour urine showed *tubercle bacilli*.

Note: February 10, 1920. His general condition was better, the urine was hazy and the posterior urethra exhibited only two very small lymphoid tubercles.

*Case 57.* A. G., age twenty-two years, July 5, 1918.

Family history: Negative.

Past history: Was in Mt. Alto Sanatorium for the treatment of his *pulmonary tuberculosis* and came from there for study.

Present illness: Frequent nocturnal emissions, burning in the fossa navicularis on urination, pyuria and tuberculosis.

Cystoscopy: Bladder and ureteral orifices were normal and the posterior urethra was filled with the lympho-cystic bodies.

Urine: *Contained tubercle bacilli.*

Chest: *Extensive pulmonary tuberculosis.*

*Case 58.* H. H. M., age twenty-seven years, February 26, 1920.

Family history: Negative.

Past history: Sent west in 1913 for *pulmonary tuberculosis* and was two and a half years in regaining his strength. Broncho-pneumonia in 1917 and influenza in 1918.

Present illness: For eighteen months he had a non-gonorrheal discharge, burning on urination and a shreddy urine.

Cystoscopy: Bladder and ureteral orifices normal. The posterior urethra showed many large cystic bodies.

Prostate: Chronic prostatitis.

Chest: "*Tuberculous infection of the lung of chronic course, involving principally the right apex.*" (Torrey.)

*Case 59.* S. K., age twenty-seven years, March 10, 1920.

Family history: Negative.

Past history: Gonorrhea four months ago. Had cough and pain in the chest for the last three months.

Present illness: Cough, burning on urination, frequency, anterior discharge and pyuria.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethral mucosa was generally inflamed and showed many of the lympho-cystic bodies.

Prostate: Chronic prostatitis.

Chest: "*Active pulmonary tuberculosis, moderately advanced in the right apex.*" (University Hospital Medical Dispensary.)

X-ray: "*Positive for pulmonary tuberculosis.*" (Pancoast.)

*Case 60.* A. W., age thirty-five years, June, 1919.

Family history: Negative.

Past history: Gonorrhea eight years ago.

Present illness: For the last five years he had had nocturia, burning in the urethra on urination and pain in the right renal region radiating to the right testicle.

Cystoscopy: Chronic cystitis with marked edema of the trigone. The posterior urethra showed many cysts.

Phthalein outputs from the kidneys were equal.

Prostate: Chronic follicular prostatitis.

Chest: "*Moderately active third stage pulmonary tuberculosis.*" (University Hospital Medical Dispensary.)

X-ray: "*Advanced pulmonary tuberculosis.*" (Pancoast.)

*Case 61.* R. D., age twenty years, June 12, 1919.

Family history: Mother and sister died of tuberculosis and brother had tuberculous hip.

Past history: Had gonorrhea three years ago.

Present illness: Urethral discharge and burning in the fossa navicularis on urination.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra shows a number of lympho-cystic lesions and two very large prostatic openings with pus exuding from them.

Prostate: Chronic prostatitis.

Chest: "*Pulmonary tuberculosis.*" (University Hospital Medical Dispensary.)

Cystoscopy: January, 1920. Bladder and ureteral orifices normal and the posterior urethra contained two small lymphoid bodies.

Chest: "*Apparently healed—in tuberculosis of both pulmonary apices but no present signs of activity.*"

Urine: *Many tubercle bacilli present in twenty-four hour specimen.*

Catheterized kidney urines showed pus from both kidneys.

Differential one-half hour intravenous phthalein test gave 25 per cent return from the right and 17 per cent from the left kidney.

*Case 62.* B. M., age thirty-eight years, September 22, 1919.

Family history: Negative.

Past history: Gonorrhea eighteen months ago.

Present illness: Burning on urination, anterior discharge and shreds in the urine.

Cystoscopy: Bladder and left ureteral orifice normal. The right orifice was slightly reddened. There was a mild basal cystitis. The posterior urethra showed many of the lympho-cystic lesions.

Prostate: Chronic prostatitis.

Chest: "*Physical signs of a lesion in the left lung.*" (University Hospital Medical Dispensary.)

Sputum: *Positive for tubercle bacilli.*

*Case 63.* O. P., age twenty-three years, 1919.

Family history: Negative.

Past history: Typhoid twelve years ago and gonorrhea two years ago.

Present illness: Urethral discharge, burning on urination and pyuria.

Cystoscopy: Bladder and ureteral orifices normal and lympho-cystic lesions in the posterior urethra.

Prostate: Chronic prostatitis.

Chest: "*Impairment at right apex posteriorly above spine of scapula, with granular breathing and moisture.*" (University Hospital Medical Dispensary.)

X-ray: "*Right upper lobe below extreme apex is distinctly suspicious.*" (Pancoast.)

Sputum: *Positive for tubercle bacilli.*

*Case 64.* F. T., age thirty-one years, December, 1919.

Family history: Negative.

Past history: Chancre three years ago with negative Wassermann tests for two years.

Present illness: For the last two years he had a morning discharge, nocturia of two times and slight pyuria.

Cystoscopy: Bladder and ureteral orifices normal. Lympho-cystic lesions in the posterior urethra.

Prostate: Chronic prostatitis.

Chest: No definite physical signs. X-ray: Negative.

Sputum: *Positive for tubercle bacilli.*

*Case 65.* W. H., age thirty years, January 3, 1920.

Family history: Negative.

Past history: Had had sacro-iliac trouble for seven years.

Present illness: Nocturia of two to three times for two years, cough with bloody expectoration, burning on urination and night sweats.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra contained many cysts.

Prostate: Chronic prostatitis.

Chest: *Impairment of resonance and muffled breath sounds at the second and third rib anteriorly on the right.* (University Hospital Medical Dispensary.)

X-ray: "*Increase in linear markings of the right apex which makes this area suspicious, no definite mottling however. Appearance is suggestive only and cannot be regarded as evidence of tuberculosis unless there are physical signs present in this area*" (Pancoast.)

Case 66. A. V., age eighteen years, March 9, 1920.

Family history: Negative.

Past history: Three years ago had an inability to hold much urine without pain, a nocturnal frequency of four or five times and a diurnal of every half hour, and great ardor urinae. Two years ago he had a discharging scrotal sinus.

Present illness: Continuance of the bladder disturbances.

Cystoscopy: Bladder and ureteral orifices normal. Trigone inflamed. Posterior urethra showed some lympho-cystic bodies, a fair-sized ulceration on the urethral floor and one very large prostatic opening.

Prostate: Chronic prostatitis.

*Both epididymi were markedly tuberculous with nodules along both spermatic cords.* There was a large scar at the site of his former sinus.

Case 67. J. B., age twenty-one years, October, 1919.

Family history: Negative.

Past history: Gonorrhea two and a half years ago with a persisting gonorrheal discharge for over a year. The residual prostatitis was treated by massage until its secretion was practically normal.

Present illness: Discomfort at the vesical outlet, morning discharge and shreddy urine. Bilateral inguinal herniae.

Cystoscopy: Bladder and ureteral orifices normal. The posterior urethra was inflamed and there were several white irregular tabs of mucosa on its lateral walls.

January, 1920: Had double herniotomy.

March 12, 1920: Had a slight morning discharge, burning on urination. Had lost weight and was having night-sweats.

Cystoscopy: Bladder normal. Trigone and ureteral orifices inflamed. The posterior urethra showed several cystic lesions and was generally inflamed.

Prostate: Secretion contained much pus.

Chest "*Definite physical signs of an old tuberculous lesion in the right upper lobe and a more active one just below it. Temperature 100.3°.*"

Case 68. W. J. M., age thirty-nine years, March 17, 1920.

Family history: Negative.

Past history: Had had *pulmonary tuberculosis for twelve years* and spent one year at Saranac.

Present illness: For a year and a half he had had recurring attacks of renal colic and for five months a nocturia of every hour, severe burning at



the vesical outlet and, during urination, along the entire urethra. Pain in the left inguinal region passing back into the rectum and pyuria.

Cystoscopy: *Contracted tuberculous bladder with a golf hole type left ureteral orifice from which thick pus emitted. The right orifice was red but normal in outline. The posterior urethra showed several cystic masses.*

Urine: *Positive for tubercle bacilli.*

*Case 69. C. A., age twenty-eight years, October 29, 1920.*

Family history: Wife died of tuberculosis.

Past history: Hematuria two years ago at which time no lesions other than the urethral cysts could be demonstrated. No further opportunity was offered at that time.

Present illness: During the last two years he had had attacks of mild hematuria and marked nocturia. For two weeks burning on urination had been present. Urine was hazy. Slight cough.

Cystoscopy: Bladder and ureteral orifices normal. The vesical outlet showed *marked nodulation of the prostate* projecting intravesically and intraurethrally. There were some cysts on these nodules and many very large ones in the posterior urethra.

Prostate, seminal vesicles and epididymi were negative to palpation.

Chest: *Very suspicious.* (Beardsley.)

Sputum: *"Loaded with tubercle bacilli."* (Beardsley and B. of H.)

*Case 70. A. L., age twenty-five years, November 1, 1920.*

Family history: Negative.

Past history: Had gonorrhea four years before. In rather a poor physical condition for several years and had been suspected of having tuberculosis two years ago.

Present illness: Had had a follicular prostatitis for two years, nocturia, a shreddy urine and slight, urethral discharge with no gonococci.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra showed many cysts.

Chest: X-ray: *"Area of infiltration in right lung at first and second interspaces."* (Pancoast.)

*Physical signs of a lesion in the right pulmonary apex. Pulmonary, tuberculosis."* (Musser.)

*Case 71. J. T., age thirty-seven years, October 27, 1920.*

Family history: Negative.

Past history: Negative.

Present illness: For three years had had pain in the glans penis and perineum, with morning drop of pus and occasional burning on urination.

Cystoscopy: Bladder and right ureteral orifice normal. Left ureteral orifice slightly suspicious. Mild basal cystitis. Cysts in the posterior urethra.

Chest: "*Crepitant râles in both apices posteriorly, with slight impairment in the right apex.*" (U. P. Med. Disp.)

X-ray: "*Marked infiltration in both apices.*" (Pancoast.)

Case 72. F. M., age forty years, August 27, 1920.

Family history: Negative.

Past history: Gonorrhea fifteen years before. Said he had been treated in Bellevue Hospital for heart disease.

Present illness: No urinary symptoms except shreddy urine.

Cystoscopy: Bladder and ureteral orifices normal. Many very large cysts in the posterior urethra.

Chest: "*Very slight impairment in left apex and slightly harsher expiration but no râles.*" (U. P. Medical Disp.)

X-ray: *Positive for tuberculosis.* (Pancoast.)

Sputum: *Loaded with tubercle bacilli.* (U. P. Lab.)

Case 73. H. S. R., age twenty-five years, November 30, 1920.

Family history: Negative.

Past history: Gonorrhea five years before, with persisting milky discharge.

Present illness: Bladder and ureteral orifices normal. Cystic bodies in the posterior urethra.

Chest: *Chronic inactive pulmonary tuberculosis of both upper lobes.*

X-ray: *Tuberculous infiltration along right vertebral border accompanying apical bronchi.*

Case 74. C. B., age twenty-one years, October 2, 1920.

Family history: Negative.

Past history: Gonorrhea two years ago.

Present illness: Had burning along the urethra on urination, a morning drop of pus and shreds in the urine. Prostatic secretion showed 75 per cent pus.

Cystoscopy: Bladder and ureteral orifices normal. Posterior urethra literally filled with cystic bodies.

Chest: *Physical signs of tuberculosis in both lungs.*

X-ray: *Rather marked general peribronchial thickening at the roots of lungs. Some of the bronchi in the upper lobes are more or less beaded, suggestive of a tuberculous process.*

*Case 75.* L. N., age nineteen years, January 24, 1921.

Family history: Negative.

Past history: Unimportant.

Present illness: During the preceeding four months he had burning in the urethra and frequency of urination with occasional attacks of hematuria.

Cystoscopy: *Contracted tuberculous bladder with ulcerations and tuberculous granuloma around left ureteral orifice which was greatly retracted. Lympho-cystic bodies in posterior urethra. Differential phthalein (one-half hour intravenous). Right kidney 35 per cent output. Left kidney none.*

Chest: *Probably slight old fibrous process in right apex.* (U. P. Med. Dept.)

Urine: *Loaded with tubercle bacilli.* (U. P. Lab.)



## URETHROSCOPIC FINDINGS IN FUNCTIONAL DISORDERS OF THE GENITO-URINARY TRACT

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It would be both interesting and useful if we could devise a formula that would correlate the urethroscopic findings and the clinical phenomena observed in the functional disorders of the male genito-urinary tract. At present we have no such formula with the result that it is impossible to visualize the urethroscopic picture in any given case, from a study of the clinical symptoms presented by the patient.

This paper is a preliminary presentation of an attempt to find a common factor in a series of consecutive cases presenting somewhat similar clinical phenomena; or to put it in another way, it is an attempt to determine whether or not certain clinical phenomena referred to the genito-urinary tract are associated with certain well-defined pathologic lesions in the deep urethra, as seen through the urethroscope.

For the purpose of the present study, cases presenting functional genito-urinary disturbances have been classified according to their predominating symptoms into three groups—sexual, urethral and those characterized by pain. Fifty consecutive cases have been selected, having well-defined clinical symptoms, which can be placed in one of the three groups just mentioned. In many of these cases there was more or less overlapping of symptoms; they were therefore grouped according to their predominating complaint.

Every case has been studied urethroscopically, and in a fairly large percentage, the urethroscopic picture has been preserved for demonstration and study by means of wax models, which portray quite faithfully the outstanding pathologic lesion as observed through the Buerger cysto-urethroscope. While there

can be no pretense of pathologic accuracy, such as a camera might portray, since they are made by hand, they constitute an honest and faithful reproduction of the most striking lesions seen through the urethroscope.

Classified according to the predominating clinical manifestation, these cases divide themselves, as follows:

	<i>cases</i>
Impotence and premature ejaculation . . . . .	21
Pain . . . . .	10
Sterility . . . . .	8
Urinary disorders . . . . .	6
Excessive nocturnal emissions . . . . .	5

Of these 50 patients, 18 admitted and 32 denied previous gonococcal infection, thus emphasizing the fact that functional disorders of the genito-urinary organs are not necessarily gonococcal in origin. The exact etiology of these non-specific cases cannot be stated with any great degree of accuracy, but close investigation into their sexual habits and history revealed the long continued practice of masturbation or withdrawal (coitus interruptus). I believe these practices, if long continued and carried to excess, are responsible for many if not all of these non-specific disturbances of function.

In considering the urethroscopic aspects of this series of cases, one is immediately impressed with the fact that the natural limitation of space within the posterior urethra, would necessarily narrow the urethroscopic study down to the verumontanum and that portion of the urethra lying behind it and known as the post-montane space. Such actually is the case, except in so far as it is possible to study any existing pathologic changes in the orifices of the ejaculatory ducts, and in the internal sphincter, which very often presents interesting and curious abnormalities.

It might be supposed, at first thought, that disorders of the urinary function would present a urethroscopic picture radically different from that observed in disorders of the sexual function; but a careful study of these cases and many more not included in this series, leads to the conclusion that there is no sharply drawn line of demarcation between them. Without going into details,

we may say that the verumontanum and the deep urethra are both involved to a greater or less degree in practically every case of functional disturbance, and that this pathologic involvement can be observed distinctly through the urethroscope. In some cases, the verumontanum seems to be normal, but even in these cases, the urethra is definitely affected. It seems that the urethra bears the brunt of the attack in every case.

Taking up our cases, in some detail, according to their clinical manifestations: In 21 cases in which premature ejaculation and various degrees of impotence were the chief symptoms, we found that 15 cases presented marked evidence of inflammation involving both the verumontanum and the urethra behind it. In 6 of these cases the mucosa bled profusely, on contact with the instrument, so great was the congestion. In 2 cases, the mucosa was irregular and jagged, as though torn up by a nail or a sharp instrument; and in 2 cases, cysts were observed attached to the mucosa. In 6 cases belonging to this group, the verumontanum was but slightly affected apparently, though the urethral mucosa was involved in varying pathologic degrees.

It is thus seen that in 21 cases presenting a somewhat similar functional disturbance, the urethroscopic picture of the verumontanum and the postmontane space differed materially though practically every case showed the presence of more or less inflammation.

In this study there were eight cases of sterility, without history or evidence of epididymitis. In five cases azoospermia was present and in 3 cases oligonecrospermia was the cause of the sterility. In the cases with azoospermia, the urethroscopic picture varied considerably. In one instance, the verumontanum was covered with cysts; in another, the postmontane space presented several cysts; in a third, the verumontanum and urethra were both much inflamed and congested; in the fourth, the verumontanum and the urethra were both slightly congested; and in the fifth case, the verumontanum seemed to be normal, but the urethra was greatly inflamed. On the other hand, in the cases presenting oligonecrospermia, the verumontanum and urethra in all three cases were considerably distorted and damaged by the inflammatory process.

Considering the 10 cases in which pain predominated: In 3 cases of pain in various parts of the penile urethra (without history of gonorrhea), the verumontanum and postmontane space were very deeply congested and inflamed; 5 patients complained of pain in voiding; in 3 of these, both verumontanum and urethra were involved, and in the remaining 2 the verumontanum was inflamed and distorted and there were several cysts on the postmontane space. Two patients had pain in the perineum; in both, the verumontanum was seriously involved; in 1 case, the postmontane space was jagged and torn up, as by a sharp instrument, and in the other, the urethral floor was covered with small tubercles. It is interesting to note that this patient presented undoubted tuberculous lesions in one epididymis and one hip joint. There were no cysts in this case.

Six cases in this series were characterized by frequency of micturition. In 4 cases, both verumontanum and urethra were seriously affected by the inflammation; in 3 cases the verumontanum was so large as to constitute in effect an obstruction to the easy flow of urine and the introduction of instruments; 1 case presented two fairly large cysts in the postmontane space. It is worthy of note, though it may have no direct bearing on the present subject, that the reaction of the urine in all cases presenting urinary frequency, was hyperacid. I believe functional frequency of urination is the result of a hyperacid urine acting on an inflamed vesical neck or posterior urethra, thus producing a more or less continuous irritability with a desire to relieve the bladder of its accumulated contents.

In 5 cases of this series, excessive nocturnal emissions were the predominating symptom. In all of them, both the verumontanum and the deep urethra were markedly affected; in addition, 1 case presented a unique telangiectasis of the verumontanum, and another case, with bloody emissions, showed a fairly large cystic body on the left wall of the verumontanum.

Cystic bodies were observed, in this series, on the verumontanum, on the postmontane space and on the internal sphincter, in 8 cases represented in every group. They do not seem to be associated with any particular functional disorder or manifestation.



It is evident then, after this brief review of the findings in this series of cases, that in every case of functional disorder involving the genito-urinary tract, there was a distinctly appreciable pathologic condition in the posterior urethra, and in nearly every case the verumontanum likewise was involved. It goes without saying, that this study has not taken into account the prostate and seminal vesicles in these cases; it need not be explained that these organs were affected to a greater or less extent in practically every case, and that the urethroscopic picture practically mirrored the pathology of the prostate and vesicles.

In closing, if any conclusions may be drawn from this necessarily imperfect study of the subject, we may say:

1. Functional disturbances of the genito-urinary tract are invariably associated with pathologic lesions in the posterior urethra.

2. These lesions usually involve both the verumontanum and the urethral canal behind it, occasionally also the internal sphincter.

3. When the urine is hyperacid, urinary frequency is likely to be the predominating symptom.

4. In 64 per cent of cases, in this series, there was no history of previous gonococcal infection.

5. Excessive masturbation, prolonged sexual excitement without gratification, and withdrawal (*coitus interruptus*) practiced for long periods, seem to be the etiologic factors in the non-gonorrheal cases.

6. Whatever the etiologic factor may be, the resulting functional disturbance does not follow any specified type, and there is no apparent correlation between the clinical phenomena and the urethroscopic picture.

7. Sexual neurasthenia, so-called is a misnomer; it should be considered an aggregation of more or less serious disorders involving one or more functions of the genito-urinary tract and associated with definite pathologic lesions in the prostate and seminal vesicles and reflected in the urethroscopic picture of the verumontanum and posterior urethra.

8. Every case of functional disorder referable to the genito-urinary tract should be subjected to thorough study and examination through the urethroscope.



FIG. 1. PREMATURE EJACULATION AND PARTIAL IMPOTENCE

Ten years duration; gonorrheal history twenty years ago. Cystic bodies attached to vesical sphincter; enlarged veru.



FIG. 2. ALMOST COMPLETE IMPOTENCE

Duration five years; gonorrhea thirteen years ago; excessive masturbation for many years; veru comparatively normal, right sulcus ulcerated and jagged.



FIG. 3. PREMATURE EJACULATION

Azoospermia; gonorrhea denied; external organs undeveloped; veru large and deformed, two urethral polyps.



FIG. 4. COMPLETE IMPOTENCE

Duration eight years; gonorrhea denied; bleeds copiously on introduction of urethroscope; veru large; floor jagged and torn up; cystic body on sphincteric margin.



FIG. 5. PREMATURE EJACULATION AND PARTIAL IMPOTENCE

Duration two years; gonorrhea twenty-one years ago; veru large; postmontane floor jagged and cut up; bleeds easily.

FIG. 6. ALMOST COMPLETE IMPOTENCE

Four years duration; few sperma, all dead; gonorrhea twelve years ago; veru much enlarged; ejaculatory ducts dilated; floor trabeculated.



FIG. 7. SAME CASE AS PRECEDING AFTER SIX MONTHS OF TREATMENT

Veru still large, floor almost normal; functionally not improved

FIG. 8. PARTIAL IMPOTENCE AND PREMATURE EJACULATION

Duration eight years; two attacks of gonorrhea, twenty and fourteen years ago; orifices of ejaculatory ducts and utricle enormously dilated; veru large and joined to a thick long ridge posteriorly.

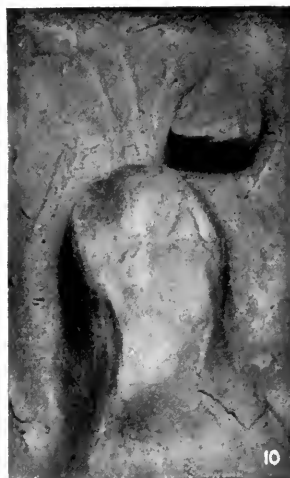


FIG. 9. COMPLETE IMPOTENCE

Duration one year; gonorrhea denied; excessive coitus four months after marriage three years ago; veru large and deformed; floor cut up and jagged; bleeds freely on examination.

FIG. 10. PAIN ON VOIDING, AND LACK OF SEXUAL DESIRE

Duration one year; gonorrhea three years ago; veru very large; cystic body posteriorly.



FIG. 11. PAIN ON VOIDING, LASTS SEVERAL HOURS; ALSO PARTIAL IMPOTENCE

Duration three years; gonorrhea twenty years previously; married sixteen years; practised "withdrawal," past ten years; veru large; two large cysts posteriorly; since destruction of cysts by fulguration, feels almost well.

FIG. 12. URINARY URGENCY AND PARTIAL IMPOTENCE

Duration four months; gonorrhea denied; veru very long, with constricting band in center.



FIG. 13. SAME AS PRECEDING, AFTER SEVEN MONTHS OF TREATMENT

Veru much smaller, though still deformed; urinary symptoms relieved, but impotence unchanged.

FIG. 14. BURNING SENSATION IN PERINEUM, MICTURIA, PAINFUL EJACULATION

Duration fifteen years; gonorrhea twenty-one and twenty-nine years previously; veru large; floor trabeculated and inflamed; ejaculatory orifices greatly enlarged; recovered under treatment.

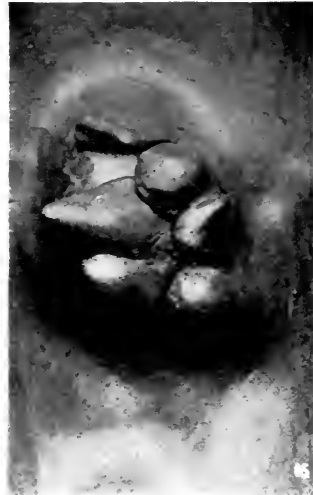
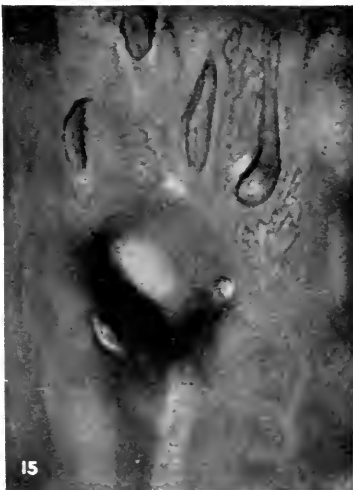


FIG. 15. SAME AS PRECEDING, AFTER SEVERAL MONTHS OF TREATMENT

Veru smaller; floor more nearly normal; grooves not so deep

FIG. 16. AZOOSPERMIA; CLINICALLY WELL OTHERWISE

Gonorrhea denied; veru very large and covered with cystic bodies; ejaculatory orifices invisible.

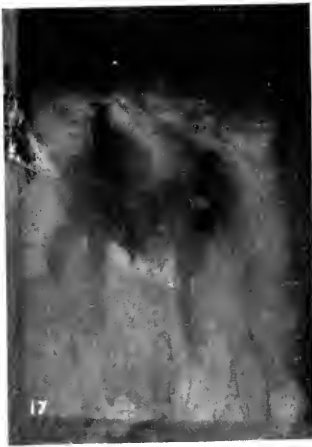


FIG. 17. FREQUENT AND PAINFUL MICTURITION

Duration five months; gonorrhea eight years ago; withdrawal past five years; veru somewhat deformed; bleeds easily; several cysts on urethral floor.

FIG. 18. MICTURIA; NEUROTIC

Duration four years; gonorrhea eight years ago; stricture 22 F. Caliber, anteriorly; veru enormously dilated and deformed, scalloped; ejaculatory orifices invisible.



FIG. 19. SAME AS PRECEDING AFTER TREATMENT

Veru much smaller and smoother in outline; functionally somewhat improved

FIG. 20. FREQUENT NOCTURNAL EMISSIONS

Duration ten years; three to five weekly; coitus once monthly; headaches, weakness, nervousness following emission; gonorrhea denied; veru large, thick ridge anteriorly; floor trabeculated; utricule enlarged.



FIG. 21. FREQUENT SEMINAL EMISSIONS

Duration five years; fourteen emissions in three weeks; gonorrhea denied; admits excessive masturbation up to eight years ago; feels bad after coitus; veru somewhat enlarged and much deformed; fairly large cyst posteriorly.



FIG. 22. FREQUENT SEMINAL EMISSIONS

Duration twelve years; three or four weekly; very nervous and emaciated; gonorrhea denied; denies excessive masturbation; veru large, deformed and covered anteriorly with dilated blood vessels (telangiectasis) posteriorly veru tapers to long narrow ridge.





## THE USE OF THE HIGH FREQUENCY CURRENT IN THE TREATMENT OF LESIONS OF THE DEEP URETHRA<sup>1</sup>

H. McCLURE YOUNG

The development of the urethroscope has been a slow process as compared with that of the cystoscope, and it is only within the last few years that we have possessed instruments affording a really satisfactory view of the deep urethra. Now that we possess them a comparatively new and wide field has become directly accessible to the urologist and it appears that we shall henceforth be able to help a large number of functional disturbances and neuroses which have appeared virtually incurable in the past.

Essential points of technique are the following: We should possess at least one irrigating instrument without a beak. This may or may not be equipped with a prismatic telescope, but an accessory channel for the introduction of the high frequency electrode is indispensable. With such an instrument it is possible to bring the entire circumference of the deep urethra into view beginning at the sphincter margin and proceeding slowly outward. The irrigating fluid is not permitted to flow continuously but is turned off from time to time, allowing the urethra to collapse somewhat for minute inspection, but as soon as the field becomes at all hazy or the urethra insufficiently distended, the flow is re-established. Very slowly the instrument is withdrawn and the entire urethra roof, floor and sides are carefully inspected as far outward as the cut off muscle. Any pathology occurring in front of this point will not be considered in this paper.

At a subsequent examination the surgeon may prefer to employ a beaked cysto-urethroscope for a further study of the

<sup>1</sup> Read before the Southwestern Branch of the American Urological Association, Kansas City, October 24, 1921.

vesical orifice and urethral floor, or because he feels that he can more easily direct the tip of his electrode. These cysto-urethroscopes have a firmly established but somewhat narrow field of usefulness. They are emphatically not the instruments of choice for a first routine examination of the deep urethra. They do not furnish a sufficiently wide field of vision and pathology situated along the roof or lateral aspects of the deep urethra will very probably be overlooked.

But a perfect view of the lesions of the deep urethra would often avail very little if we did not possess a means of immediately applying the necessary treatment with great accuracy under the control of the eye. This is furnished us by the high frequency current. This is used either for deep or very light cauterization and may at times be supplemented by medicaments instilled through a ureteral catheter.

The lesions commonly encountered are:

1. An inflammatory overgrowth of the mucous membrane which may take the form, (a) of a generalized hypertrophy of the mucosa throwing it into rather coarse folds and rugae, or (b) the more localized hypertrophies known as polyps. Often both conditions are present.

2. Granular areas, fairly well localized but not sharply outlined as a rule. In long standing cases these may have undergone a rather exuberant proliferation, giving rise to a sort of tumor, a granuloma. These granulomata present a very characteristic appearance. They are sessile and surrounded by an inflammatory zone which gradually shades off into the more healthy mucosa. They are covered with a thin veil of muco-pus which may have become partially detached so as to float in the irrigating fluid. The surface bleeds readily and presents often a few very small pearly looking cysts. These granulomata are in all respects similar to those found in the bladder accompanying pyelitis with a severe cystitis, and their appearance is so characteristic that they cannot be confused with papillomata or other true new growths.

Now the overwhelming majority of all tumor formations found in the deep urethra belong to one or the other of these two classes,

the polyps and the granulomata, both of them inflammatory lesions. True new growths are rare in this region. Papillomata are not uncommon in the bladder, but I believe them to be very uncommon in the deep urethra. There is too much confusion in the literature on this subject at the present time. In fact one can see illustrations of typical polyps described as papillomata in some of our best text books.

3. Small sinuses running out of the deep urethra into the substance of the prostate are very common and should always be carefully looked for. The orifices of these are large enough to admit the tip of a ureteral catheter and the pocket can be sterilized by the instillation of a little silver nitrate solution. Also a Bugbee fulgurating electrode can be introduced and a light cauterization performed. These sinuses may be found anywhere between the verumontanum and the vesical orifice, but are commonest a little behind the verumontanum on the urethral floor. Some are round and appear as if punched out but others are oval and with healthy looking margins. Many of these I believe to be dilated prostatic follicles but some are doubtless the remains of old abscesses.

Varicose veins sometimes occur in the deep urethra. I have seen a case where the entire deep urethra presented the appearance of a mass of purple grapes. This was many years ago and fulguration was not applied.

Finally I should like to call your attention to a method of fulgurating offending prostatic lobes. We are all familiar with the work of Luys of Paris and his "forage" of the prostate. This we have modified by the use of the sheath or female blade of the Young punch. This is used to hook the prostatic lobe forward and protect the rest of the urethra by isolating what we wish to destroy. The sheath is introduced with its obturator, which latter is then withdrawn and the prostatic lobe or median bar is caught in the fenestrum of the instrument exactly as would be done if we were about to perform the ordinary punch operation. The field is then wiped dry and anesthetized after which the stiff fulgurating electrode is passed down and embedded into the prostatic tissue. The electrode being stiff cannot depart from the

axis of the instrument and it is only just long enough to reach across the fenestrum. It is easy to tell by sense of touch alone when the electrode has penetrated the prostatic tissue and only so much can be burned as lies within the grasp of the instrument. One can therefore burn this very thoroughly. Then the electrode is removed, the prostate disengaged from the instrument and the obturator reinserted. With the fenestrum thus sealed the sheath is withdrawn leaving the burned tissue to slough away.

The results of this operation will be reported more fully at another time. I began to use this method in September of this year. I have found it exceedingly simple. The electrode is cheap and will not easily get out of repair. Accidents are virtually impossible. End results however, cannot be reported as early as this.

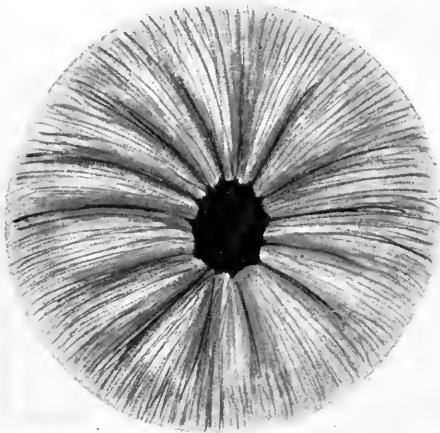


FIG. 1

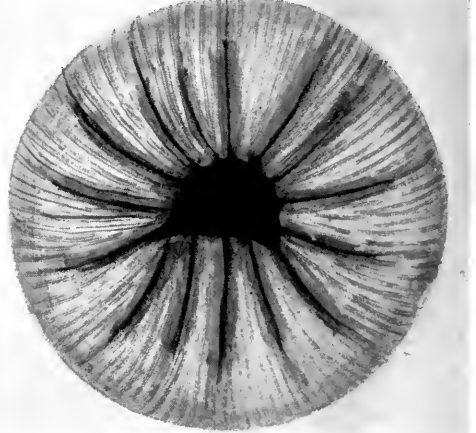


FIG. 2

FIG. 1. INTERNAL SPHINCTER MARGIN AS SEEN FROM THE DEEP URETHRA BY MEANS OF THE BUERGER UNIVERSAL URETHROSCOPE

FIG. 2. A DIFFERENT TYPE OF SPHINCTER MARGIN SHOWING SOME THICKENING OF THE MUCOSA AND ELEVATION OF THE FLOOR

This is not a median prostatic bar. There was no residual urine in this case. The same picture is sometimes seen in the female. Buerger Universal urethroscope employed.

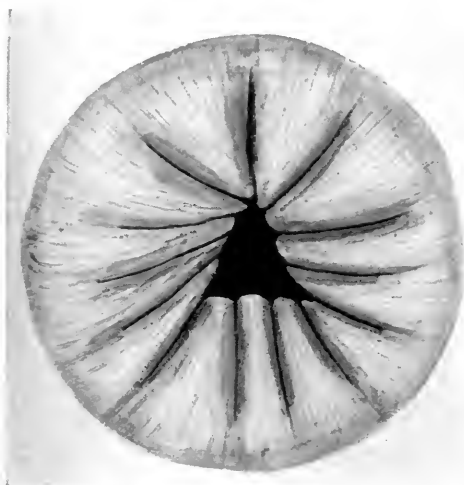


FIG. 3

FIG. 3. ANOTHER TYPE OF SPHINCTER MARGIN

This patient had a chronic prostatitis. There is some swelling of the prostatic lobes but there is no hypertrophy. Buerger Universal urethroscope employed.



FIG. 4

FIG. 4. POLYPS ON THE SPHINCTER MARGIN

These are a product of inflammation and not new growths. Braasch cystoscope employed. This patient had suffered many years with a chronic prostatitis and seminal vesiculitis with great frequency of urination. These polyps were removed with the Braasch punch. Hemorrhage was excessive and the method has not been employed since.



FIG. 5

FIG. 5. CYST ON SPHINCTER MARGIN SEEN AT VERY CLOSE VIEW WITH THE BROWN-BUERGER CYSTOSCOPE

It was destroyed at a subsequent examination by painting the region with 50 per cent silver nitrate through a straight endoscopic tube.



FIG. 6

FIG. 6. POLYP ON SPHINCTER MARGIN FULGURATED THROUGH THE BRAASCH CYSTOSCOPE

Patient was a woman who had suffered for years with intense urgency. She was greatly relieved and the removal of a urethral caruncle at the meatus restored her to a practically normal condition.

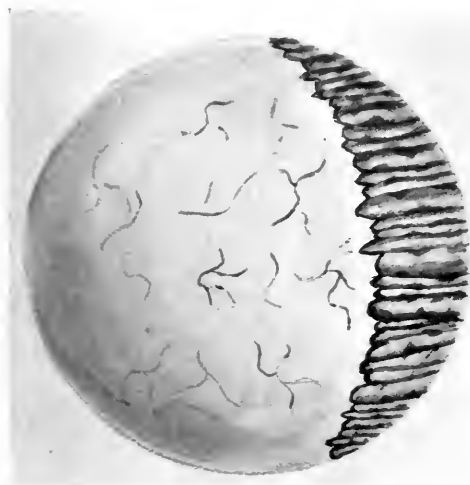


FIG. 7

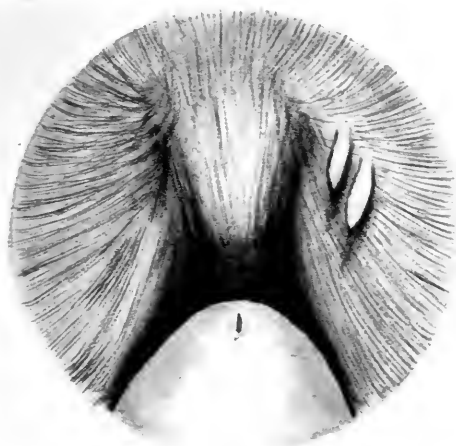


FIG. 8

FIG. 7. PECULIAR HYPERTROPHY OF THE MUCOUS MEMBRANE INVOLVING THE LEFT HALF OF THE SPHINCTER MARGIN AND EXTENDING DOWN INTO THE DEEP URETHRA AS FAR AS THE VERUMONTANUM

There were folds, rugae and sulci along the roof of the deep urethra. A great deal of fulgurating was necessary before this patient's symptoms abated. He still has a discharge and is still under treatment. McCarthy's cysto-urethroscope employed.

FIG. 8. TWO SMALL POLYPS HANGING FROM THE LEFT WALL OF THE DEEP URETHRA

There was a chronic prostatitis with considerable swelling of the gland, and other polyps were found on the roof. Patient had been through a protracted gonorrhea three years before. Only complaint was a mucoid discharge. Seen with the Buerger Universal urethroscope.

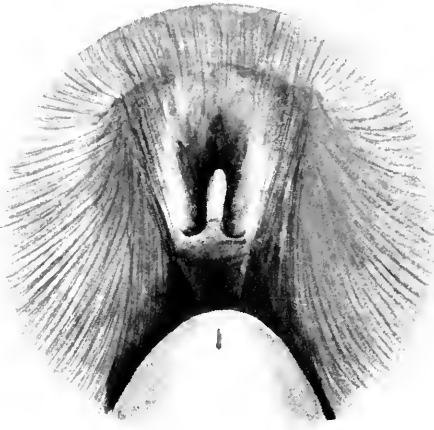


FIG. 9

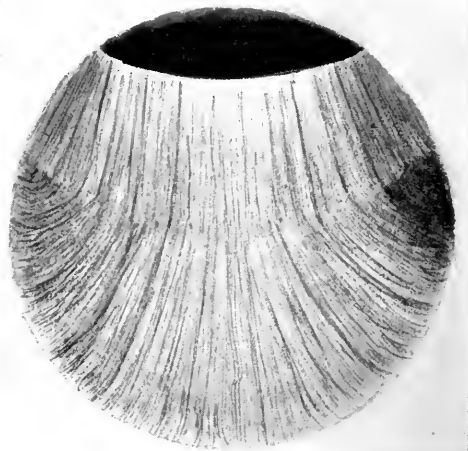


FIG. 10

FIG. 9. SMALL POLYP ON THE FLOOR OF THE DEEP URETHRA JUST BEHIND THE VERUMONTANUM

Some disturbance of the sexual function and pain on urination. There was prostatitis and seminal vesiculitis. This polyp was destroyed by fulguration through the Braasch cystoscope. There was great improvement with symptomatic relapse a year later. Vasopuncture.

FIG. 10. ELEVATION OF SPHINCTER ORIFICE WITH ABRUPT DESCENT INTO THE DEEP URETHRA

The orifice was so elevated that its upper margin could not be seen at close vision with the Buerger Universal. Previous cystoscopy had revealed an elevated trigone with slight notch of the sphincter margin above. There was never more than 1 cc. of residual urine obtained. A case of chronic prostatitis of long standing with some sclerosis in a patient of fifty. Same case as figs. 11 and 12.



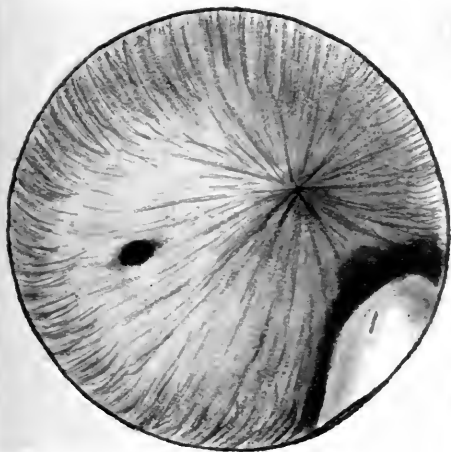


FIG. 11

FIG. 11. SAME CASE AS FIGURE 10

A sinus running into the prostate just above and lateral to the verumontanum. This is a hole of the punched-out variety and is probably the result of a small abscess.



FIG. 12

FIG. 12. SAME CASE AS FIGURE 11

A Bugbee electrode has been inserted and the lining of this sinus lightly cauterized. Patient's complaint was of frequency and urgency. He has also been treated by massage and dilatation. At present he is free from symptoms.



FIG. 13



FIG. 14

FIG. 13. ORIFICE OF DIVERTICULUM IN THE DEEP URETHRA

This hole would open up widely as soon as the irrigating fluid was permitted to flow. Same case as figure 14. Braasch cystoscope employed.

FIG. 14. SAME CASE AS FIGURE 13 WITH IRRIGATION ESTABLISHED

Infection was severe in this case and patient was incapacitated. A supra-pubic cystotomy had been performed elsewhere without relief. There was no opportunity for further study or treatment of this case. Braasch cystoscope employed.

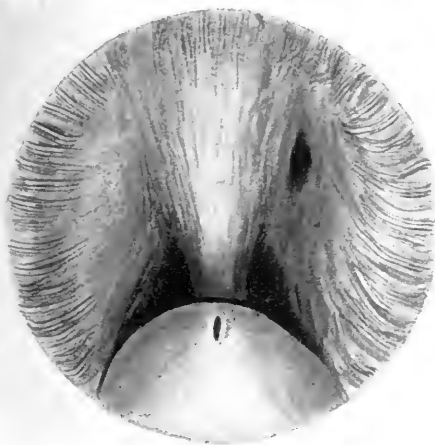


FIG. 15



FIG. 16

FIG. 15. A HOLE OF THE PUNCHED-OUT VARIETY

This was fulgurated and also twice washed out with 10 per cent silver nitrate instilled through a ureteral catheter. When last examined the hole was filled up with granulation tissue. This patient had a chronic prostatitis with loss of the sexual function for fifteen years. Since this treatment he has found himself competent but still not normal. Buerger Universal urethroscope employed.

FIG. 16. TWO LARGE OPENINGS ON THE FLOOR OF THE DEEP URETHRA

These present a quite different appearance from the two shown in figures 14 and 15. They are probably dilated follicles and their margins present a healthy appearance. These holes have been found by me in this locality only, though they are rarely as symmetrical as this. Sometimes they are more nearly circular and appear as much as half a centimeter in diameter. It may then be possible to see into them 0.5 cm. Where infection is suspected, a 10 per cent silver solution is instilled.

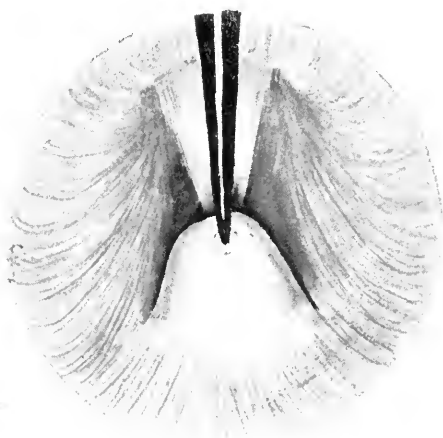


FIG. 17

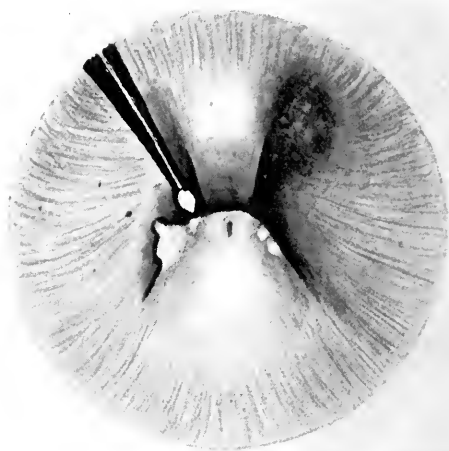


FIG. 18

FIG. 17. THIS WAS A CASE OF SEMINAL VESICULITIS AND PROSTATITIS IN A PATIENT WHO HAD PRACTISED WITHDRAWAL FOR MANY YEARS

There was marked sexual decline. Spermatozoa were quite constantly found in the urine. The utricle was found swollen and distorted with a grey secretion exuding. Tip of Bugbee's electrode is shown inserted into the utricle. A light cauterization was carried out and later the region assumed a more healthy appearance. Symptoms were much improved when last seen. Buerger Universal urethroscope employed.

FIG. 18. A CASE OF CHRONIC POSTERIOR URETERITIS

The site of a gray patch of adherent pus upon the verumontanum is about to be fulgurated. Note particularly the granular area above the verumontanum and to the left of the median raphe. It has a washed appearance so that details are not sharply defined. It is but little elevated. Sometimes they are seen elevated as much as the verumontanum itself, but their appearance is quite different from that of polyps or of true papillomata. McCarthy's cysto-urethroscope employed.

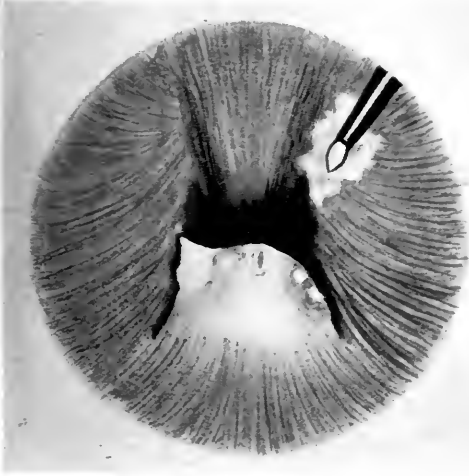


FIG. 19

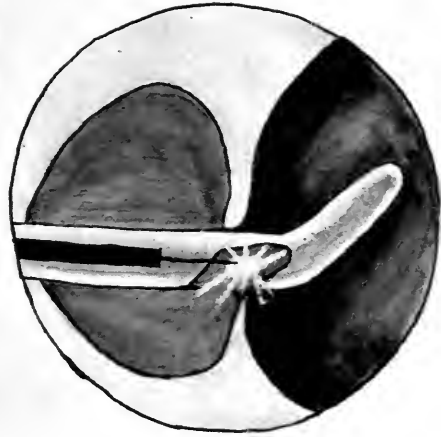


FIG. 20

FIG. 19. SAME AS FIGURE 18

The granular area has been cauterized by fulguration. McCarthy's cystourethroscope employed.

FIG. 20. A DIAGRAM

The middle prostatic lobe has been caught in the jaw of the punch and transfixed with a fulgurating needle. It is shown in the act of being cauterized. Note that the needle cannot depart from the long axis of the instrument. Neither can it burn the roof of the urethra or any portion of the prostate not within the fenestrum. Hugh H. Young's prostatic punch is the instrument employed.



## TYPES OF NEPHRITIS WHICH LEAD TO UREMIA<sup>1</sup>

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*New York*

There is a tendency in some quarters to confine the use of the term uremia to an increase of urea in the blood or serum beyond normal limits. And while this is the literal meaning conveyed by the word, general usage has attached to it a broader significance. As originally used, too, it was not the increase in urea that was designated uremia, but the clinical symptoms which were supposed to be effected by the increase. Uremia today connotes certain syndromes, predominantly psychomotor, which are related to renal disorders and are believed to be due to some form of intoxication. An increase of urea and of other nitrogenous bodies in the blood may, and often does accompany the clinical manifestations of uremia, but this is not invariably the case, since pronounced symptoms and even a fatal issue not rarely does occur without detectable increase in the non-colloidal nitrogen of the blood.

This fact, namely, that uremia of a fatal degree, may develop without increase of urea in the blood raises some questions relative to the diagnosis of the syndromes which might be touched upon in passing. Under the limitation of definition that uremia is a consequence of renal disease, it becomes necessary in any suspected case to demonstrate renal disease, and not this alone but also a degree of severity of renal disorder sufficient to predispose at least to an intoxication. As every one knows, much reliance is placed upon the results of blood chemistry to determine nephritis and when this method fails to give definite facts diagnosis becomes uncertain. No other method is quite so definite. Yet there are undoubted cases of severe nephritis without azotemia. On the other hand the symptoms of uremia

<sup>1</sup> Presented to Congress International d'Urologie, Paris, July, 1921.

may in large measure generally, and in reference to the psychomotor disorders particularly, be completely simulated by other diseases. If, then there be present concurrent renal disease, diagnosis becomes impossible. The diseases which are most frequently mistaken for uremia are cerebral arterio-sclerosis and thrombosis of the cerebral arteries. By the very nature of these diseases, some evidence of nephritis is often if not usually detectable. The point I desire to emphasize in this reference is that conceptions of uremia based solely on clinical and laboratory data are not reliable and require constant check by post-mortem examination to exclude simulating diseases. Uremia can not be recognized from necropsy data; it can only be suspected. But other diseases which might be and are in fact, mistaken for uremia can be demonstrated at autopsy.

Now it has been held for some time by internists that there are several types of uremia. At times these types appear in a clear cut syndrome as for example, in eclamptic, or epileptiform uremia. Often types merge with a confused clinical picture resulting. There is available now considerable evidence in support of a conception of three simple uremic types; epileptiform uremia; lethargic, or asthenic uremia; and sophtose uremia. The first is due as I have shown to a specific toxin, while the asthenic type is a slow poisoning caused by accumulation in the tissues of katabolic products, normally excreted in the urine: urea, creatinine, etc. And the third type, sophtose uremia, is resultant upon marked edema of the brain, or more exactly, possibly, serous encephalitis. As already mentioned although these types often merge yet they are not infrequently observed as pure types. But it is not alone symptomatology which demarks them, but also certain rather definite metabolic peculiarities. The convulsive uremia and lethargic uremia are associated usually with nitrogen retention and azotemia, while the sophtose type is characterized by retention of salt, and water, predominantly. It is not relevant to the theme to discuss in detail these uremic types and their bio-chemical relations. But it may be noted that whereas lethargic uremia is associated with extreme degrees of nitrogen retention, surpassed only by some cases of



anuria; convulsive uremia shows evidence of nitrogen retention only in a moderate degree, but is, however, characterized by a peculiar toxic base, detectable by appropriate methods in the blood, but not to be found in other types of uremia. These facts in relation to uremia generally and its peculiar types lead us to a consideration of the defects or disorders producing the disturbances in metabolism which are the immediate causal factors.

In the present incomplete state of our knowledge it is not possible in many instances to separate the effects of impaired function of the kidney from effects of more profound metabolic disorders. Of course in a properly refined sense the renal defect as such is consequent to some deeper mal-adjustment. Concerning the more obvious conditions met with in nephritis there seems, however, less uncertainty. For example, the retention of nitrogen which leads to azotemia, depends apparently upon impairment of renal function purely. There are a definite number of renal elements, a glomerulus and its tubule representing an element. When the number destroyed, or temporarily ineffective by reason of disease, exceeds two thirds of the total, those remaining intact can not fulfil the demands of excretion. This elemental idea of impaired function does not, however, exclude the conception of concurrent deeper chemical disorder. We must, however, confine attention mainly to the more obvious aspects of nephritis and these facts, though inadequate, relate to the conception of function. An increase of the urea in the blood accompanying some forms of nephritis has been recognized since the time of Bright and the heightened non-protein nitrogen or non-colloidal nitrogen was next discovered. But finer differentiation waited upon the development of refined methods in chemistry. With the advent of these methods came the fact that certain bodies, for example, uric acid are eliminated with difficulty much before the period of urea retention; and that creatinine is the last substance to be affected as renal degeneration proceeds. Consequently, as a corollary to the theory of defective function must be added the idea of selection in that some substances are eliminated with ease while others meet difficulty or

fail entirely. Two possible explanations are offered and which is approved depends at present, upon the bias of the student. Adherents of the filtration conception of renal function would lean largely to purely mechanical factors for elucidation of selective excretion while the supporters of the theory of secretory renal function find a satisfactory answer in the injury of cell groups in various parts of the renal tubule. It seems best to admit in all candor that the physiology of the kidney is still quite concealed. The effect of anuria is known, the results of renal disease produces similar chemical changes in the blood, we assume an analogy. Both cause an accumulation of nitrogen waste products in blood and tissues and symptoms which are in essentials alike and peculiar. The more common types of uremia are associated with, and are probably dependent upon nitrogen retention, in some degree at least. And then we ask the question, what renal lesion is directly accountable for this specific failure in excretion? In the endeavor to answer this question a vast amount of work has been done attempting to correlate clinical data with the lesions found in kidneys post-mortem. None of these endeavors has been rewarded with marked success. Usually a new system of classification of renal disease has been proposed which suggests to the skeptically minded a partial failure at least. These attempts ignore the broader experience afforded by the morgue, namely that very severe degrees of renal degeneration are often observed in cases unassociated during life with symptom, sign, or functional test indicative of nephritis. The fact is the kidney is a compound organ and examination of one section only equivalent perhaps to several elements in the organ gives insufficient data as to the damage of all the others. In relation to other analogous organs this fact is admitted. For example in estimating the symptomatology of thyroid disorders from the histological picture of the gland not only series of sections are required but also a chemical analysis of iodine content of the gland as well.

In a gross and general way the deductions made in the clinic respecting nephritis are confirmable at autopsy, but an estimate as to whether glomerulus or tubule or which part of the tubule

is chiefly at fault in any specific case can hardly be supported. Usually nitrogen retention is associated with those renal lesions which are predominantly degenerative and tend to be atrophic. From the experimental side the problem has not received much light due to the fact that poisons which injure the kidney significantly are not selective in their action. Uranium which has been employed extensively to produce nephritis in animals is not confined in its effects even to the kidney and the deductions made from studies on uranium nephritis have not been convincing. Nitrogen retention may be induced by uranium poisoning but the question has not been answered as to whether this retention is a result of injury of glomerular capsule, tubule or vascular supply. The brunt of injury in the kidney from diphtheria toxin appears to fall upon the glomerular capsule, judging from the evidence afforded by microscopic study of sections; yet here again there is more or less change resultant in other renal cells and the not-to-be-forgotten fact that this toxin affects many functions and produces lesions in other organs than the kidney. Usually the nephritis produced by moderate doses of diphtheria toxin is not accompanied by significant azotemia. Bearing in mind the incompleteness of the evidence and the many disturbing factors affecting this evidence we can not draw deductions from these experiments even though it may be said in general that those renal poisons (uranium, chromium, mercury) which induce azotemia show their most apparent lesion in the renal tubule.

Essentially the question here is that of the physiological function of the various elements in the kidney. And there is no consensus of opinion even among physiologists, nor agreement even as to whether secretion, or simply filtration best expresses the renal function.

When we attempt to consider the excretion of water and the inorganic salts we are not able to be any more precise or definite. Essentially the same methods of investigation have been applied to the problem modified, however, to meet special requirements. It is neither necessary nor profitable to discuss these methods nor to criticise the results secured by them. The ultimate signifi-

cance of these facts can be tested by one question: Is it now possible for the pathologist by examination of the kidneys in any case to recount the clinical manifestations of the disease with a degree of approximation practicable in many other advanced organic disorders? Few indeed, would claim such nice discernment. If the test of science be the ability to predict, then the above question aids us to orient ourselves in spite of some confusion in the available evidence.

The anatomical point of view of disease is inadequate in estimating the disorder of any compound gland because it fails to consider that in health the number of functioning elements is ever in excess of the extreme demand. That is to say there is a margin of surplusage in these elements, and reduction in their number is possible before the intact elements are placed under a test strain. Due regard to this fact has changed in some degree our point of view, recognizing as we do that even considerable destruction of the kidney is not incompatible with quite adequate performance of physiological requirements. Considerations of this nature are at the foundation of the present emphasis put upon the study of function. Viewing the kidney from this physiological aspect we recognize that defective function may be manifested in several respects; the retention of nitrogen compounds, inorganic salts, and water. These deficiencies may be single and isolated phenomena or they may be associated and merged together. Thus we have clinical syndromes associated with an increase of non-protein nitrogen in the blood and tissues, others characterized by salt and water retention and edema, others again where both of the above disorders appear together. This of course is well known and generally accepted. Can we then state as a corollary to this theorem that nitrogen or salt retention is directly evidenced by changes in the blood composition and hence detectable by suitable methods? On this assumption many practical deductions are being utilized in the clinic and in my opinion without proper warrant. In the first place it has been possible to show that nitrogen retention may occur in very sick nephritics without increase of the non-colloidal nitrogen in the blood. This fact was arrived at by very careful

measurement of the nitrogen ingesta and excreta, thereby determining the amount of nitrogen retained by the patient, together with frequent analyses of the blood during the period of observation. The nitrogen retained is held in the body tissues but still as non-colloidal nitrogen, not as amino-acid or new tissue. Further supportive evidence has been derived from animal experimentation conducted along similar lines. A not very different state of affairs has been observed at times respecting sodium chlorid retention. It may or may not be in excess in the blood and of course salt retention without edema is observed, although unusual,—the so-called “dry retention.” Unlike the salt retention which accompanies many acute infections, pneumonia and rheumatic fever for example, the sodium chlorid retention of nephritis is believed to be referable to a failure of excretion in the kidney and in that respect quite comparable with retention of nitrogen substances. We find ourselves confronted again with our original question in a re-statement. Have we any data indicating what specific cells are at fault for these functional defects?

Acute nephritis in young individuals is apt to present a simplicity in its lesions quite in contrast with the complexity of chronic nephritis. In scarlet fever and diphtheria two forms of nephritis occur chiefly which have been designated glomerular and interstitial, following the descriptions of Councilman. While occasionally these types of nephritis may merge, they are usually simple and clear cut and the lesions in each are to a considerable extent distinct and confined to particular cellular structures. Now while the interstitial lesion is more apt to implicate the tubular cells in the inflammatory reaction this lesion is accompanied by slight, if any defect in excretion of water, nitrogen or salt, except when the glomerulus also shows lesions postmortem. Glomerular nephritis on the other hand is manifested clinically by a fall in urine volume, a retention of nitrogen, and not infrequently, of salt, and may end in the uremic syndrome. On this evidence alone our problem would be much simplified and we should be forced to assigning to the glomerulus not only the excretion of water and some salt, but also a much larger fraction

of the nitrogen bodies than we have heretofore believed. There are, however, equally important clinical facts which can not be ignored and I shall confine my attention to one of these. Amyloid disease of the kidneys is peculiar in the fact that the glomerulus appears to be especially selected for this form of degeneration. This fact is well known and has been remarked repeatedly by morbid anatomists. Yet amyloid degeneration of the kidneys is not ordinarily accompanied by those functional deficiencies which have been observed in the glomerular nephritis of scarlet fever, and moreover, amyloid kidney but very seldom leads to uremia. This single fact even were it unsupported by other data, is to some of us a serious obstacle to assigning to the glomerulus the important determinant rôle in the development of uremia.

Confining ourselves strictly to facts we have evidence at present only that uremia in any of its forms is a result of impaired renal function, this modicum of evidence is always procurable. Furthermore that the degree of impairment is directly proportionate to the number of renal elements (tubule and glomerulus) that is damaged seems quite probable, although not established. We should find then the solution to our query concerning the uremic producing type of nephritis not in a type, but rather in a degree of severity, not a qualitative, but a quantitative relation.

## FOREIGN BODIES IN THE BLADDER

R. V. DAY

*Los Angeles, California*

Having recently extracted a broken-off hatpin from the bladder of a man with a Buerger cystoscopic snare, I am constrained to summarize the various methods of removing foreign bodies from the male bladder.

The female bladder is not infrequently found to contain very divers articles; however, the short, straight and dilatable urethra renders them quite easy of extraction. It is a more difficult procedure in the male and only these will be treated here.

We, personally, have found quite a variety of foreign bodies in the bladder—for example, chewing gum, paraffin, broken-off pencils, small irrigating nozzle, hairpins and hatpins. Any of these may be the nucleus of a stone or simply encrusted more or less completely with the urinary salts. These foreign bodies have been removed after various lengths of time, from a few hours to months or years. In the recent cases, infection has seldom been present; in the cases of longer standing, infection is apt to be present and, in the long-standing cases, it is pretty sure to be present.

Various methods besides cystotomy have been used for their removal. The instrument that has served us with greatest frequency is a foreign body extractor (fig. 1) of rather small caliber, exactly similar to a lithotrite except the female blade has no fenestrum, is cupped and is so blunt that it could not possibly do serious injury to the bladder mucosa. This instrument is a type made by Collin of Paris some twenty-five years ago and is very difficult to obtain nowadays. With it one can easily search for, pick up and remove pieces of chewing gum, paraffin, occasionally small calculi and with it we have been successful in one case in removing a broken-off pencil and, in



FIG. 1



FIG. 2

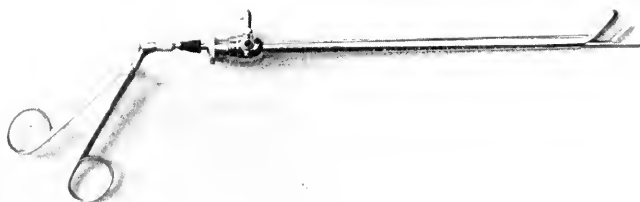


FIG. 3



another, a small irrigating nozzle. Of course, the ordinary lithotrite (children's size) is sometimes used in the same manner; but in its use the bladder mucosa is much more apt to be injured. In removing paraffin, chewing gum and other foreign bodies lighter than water, one must bear in mind to fish for them where the air bubble would be. If paraffin or chewing gum is allowed to remain in the bladder some considerable time, of course, it will become encrusted with the urinary salts and sink to the bottom.

Employment of cystoscopic forceps through the operating cystoscope may be successful; but our greatest difficulty has been their frailty and tendency to break when sufficient pressure on the scissors handle is made to grab the foreign body firmly enough to drag it through the urethra or cystoscopic sheath.

Recently I was enabled to withdraw a broken-off hatpin from the bladder by means of snaring the shaft with a Buerger cystoscopic snare introduced through an operating cystoscope (fig. 2). It was necessary to grab the two ends of the snare wire in a forceps and twist them tightly to hold the shaft of the hatpin. The snare slipped off at the first attempt at withdrawal but held at the second. The cystoscope and snare were withdrawn together, the hatpin following the tip of the cystoscope. At the angle presented in the illustration, one would expect the urethra to be torn somewhat; however, the hatpin was removed at 11 a.m. and the next morning the patient's urine was clear, sparkling and free from any trace of blood discernible to the naked eye.

The cystoscopic rongeur of Kretschmer or Young is often useful, but in a large bladder with the foreign body floating at the top or attached to the site of an old suprapubic cystotomy wound it is difficult to seize, for in the attempt the fluid is usually clouded by blood. However, if the object is attached to the sides or base of the bladder, this instrument is often invaluable.

On one occasion, we were able to remove a small stone on the base of the bladder with a urethral alligator forceps through the sheath of a Young's punch after other methods had failed.

A method by which I have been able to extract an oval-shaped stone with the small end projecting into the bladder through the ureteral meatus was as follows (fig. 3):

A large sized Braasch cystoscope no. 25 Charriere was used, carrying a single catheter guide capable of taking a size no. 11 Charriere. Through the catheter guide in the cystoscope was introduced an alligator forceps shown in figure 3.

An alligator forceps must be selected that is perfectly cylindrical in its cross-section throughout its length. So many of the forceps on the market are not only too large for the catheter guide, but are increased in size and elliptical in cross-section just back of the jaw, and consequently will not pass through the catheter guide. Such a forceps can be obtained from Kny Scheerer Company, catalog number D 1290, or the Kretschmer forceps manufactured by V. Mueller and Company. With this, one can obtain a better grip on the stone than with the usual flexible cystoscopic forceps employed through the indirect cystoscope. If the stone is small enough to be extracted through the cystoscopic sheath, one may remove it there and then. If not, the cystoscope must be withdrawn and the calculus removed from the bladder by some other method.

## ATROPHIC PYELONEPHRITIS<sup>1</sup>

WILLIAM F. BRAASCH<sup>2</sup>

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247-

The type of chronic renal infection most frequently observed is bilateral pyelonephritis. The usual clinical course of this condition is a progressive chronic urinary infection with continuous frequent micturition, dysuria, and a moderate degree of intermittent pain referred to either renal area. Although doubtlessly in a large number of patients the condition eventually disappears it often persists and the patient succumbs after many years with symptoms of terminal renal insufficiency. At necropsy the kidneys are found to be somewhat smaller than normal and characteristic, pathologically, of interstitial nephritis and to have many areas of round-cell infiltration and a slight degree of dilatation of the renal pelvis and ureter.

Pyelonephritis is as a rule not regarded as a surgical disease of the kidney for two reasons: (1) acute infections usually resolve spontaneously, and (2) chronic infections are almost always bilateral and respond in greater or lesser degree to medical treatment. Unilateral pyelonephritis, which does not respond to medical treatment, becomes a surgical condition and usually demands nephrectomy. The several forms of pyelonephritis which may be considered surgical are unilateral acute septic pyelonephritis, pyonephrosis, and atrophic pyelonephritis. I shall discuss the last condition in this paper.

Atrophic pyelonephritis is distinguishable from chronic bilateral pyelonephritis from both clinical and pathologic points of view. The urinary symptoms are less severe and are usually not progressive; the pain is unilateral and may be more severe,

<sup>1</sup> Presented before the Tri-State Medical Meeting, Portland, Oregon, June 30, 1921.

<sup>2</sup> Section on urology.

and is frequently accompanied by evidences of acute renal infection. Usually but one kidney is affected, and when removed, it is found to be greatly reduced in size. The atrophy may be confined largely to one-half of the kidney. On section marked cicatricial changes are apparent. There is frequently a well marked dilatation of the renal pelvis, although to a much less degree than that found with primary hydronephrosis.

Twenty-eight patients have been observed at the Mayo Clinic on whom a diagnosis of unilateral atrophic pyelonephritis was made; twenty-two were operated on. In contrast to bilateral pyelonephritis, which predominates markedly in the male, it was found to occur in seventeen female patients and eleven male patients. The onset of symptoms appeared in the fourth decade in twenty-two patients (80 per cent). The average age was thirty-eight years. The average duration of symptoms was six years and four months.

#### CLINICAL DATA

*Symptoms.* Unilateral pain referred to the kidney area is probably the most common subjective symptom. The pain is described either as a dull ache persisting for a short period, or appearing in acute attacks. It was present in twenty-six patients. It was described as acute in ten patients, and dull and prolonged in sixteen. It was referred largely to the renal area in seventeen patients and to the upper abdomen in five. The pain, in several patients, did not appear until after vesical symptoms had persisted over a period of many years. Frequent micturition and dysuria, the usual symptoms, were present in twenty-five patients. Although these symptoms were persistent with the majority of patients, with several they had become dormant at the time of examination; with others they recurred at intervals. Hematuria of slight degree and evidently of vesical origin occurred in five patients. Definite attacks of fever and chills and other evidence of acute renal infection recurring at irregular intervals were present in eight patients.

*Physical examination.* The general physical examination is usually negative, except, of course, during the acute attacks. In

two cases a fistula persisted from previous drainage of the kidney. In one case there was evidence of a recent perinephritic abscess. Urinalysis in twenty-five cases demonstrated the presence of pus cells; the urine in three was negative. In the majority of cases the amount of pus was only moderate. The total renal functional tests were normal in every case. Coincident infection in other organs was noted in several cases. Foci of infection such as dental sepsis and infected tonsils were found in practically all patients in whom they were searched for.

The importance of primary foci of infection such as may exist in the teeth or tonsils has recently been emphasized by the experiments of Bumpus and Meisser.<sup>3</sup> A careful search should therefore be made in order to safeguard the remaining kidney, and if any focus exists it should be removed.

#### CYSTOSCOPIC DATA

The diagnosis of atrophic pyelonephritis is best established by means of cystoscopic data. In this condition, in contrast to bilateral pyelonephritis, the bladder is usually found on cystoscopy to be involved only to a moderate extent or not at all. It is not unusual to find evidence of more or less chronic infection around one meatus, although in some cases it may appear quite normal. Evidence of diminished renal function may often be inferred from the occasional feeble spurt of urine, as compared with hypersecretion from the normal side. The urine from the affected meatus may be turbid, although in some instances it is fairly clear. The ureteral catheter rarely meets with any obstruction in its course to the renal pelvis where there may be a slight amount of residual urine. The rate of secretion from the atrophic kidney may be perceptibly less than that on the normal side. The urine catheterized from the affected kidney usually contains only a moderate number of pus cells and occasionally none. The urine from the opposite kidney was found to be normal in all but one patient in whose urine a moderate number of pus cells was found.

<sup>3</sup> Bumpus, H. C., and Meisser, J. G.: Focal infection and selective localization of streptococci in pyelonephritis. *Arch. Int. Med.*, 1921, xxvii, 326-337.



FIG. 1. CASE 282396

Pelvis and calices obliterated by atrophic changes

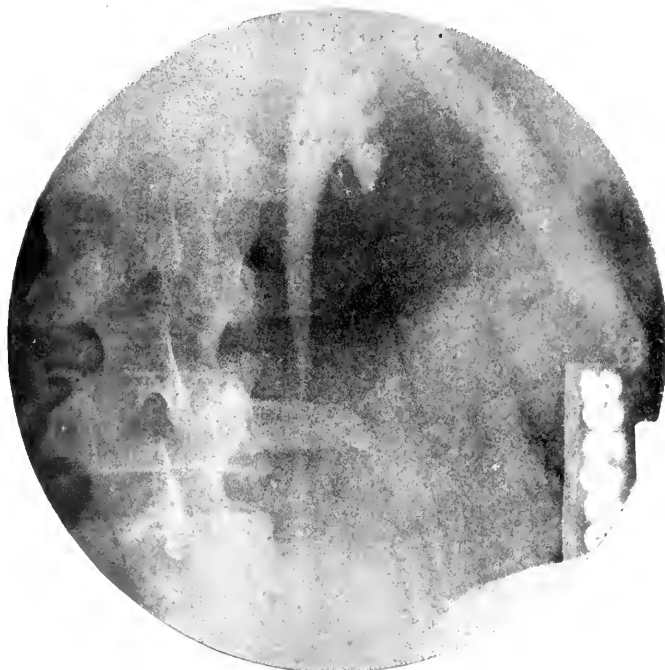


FIG. 2. CASE 235566

Reduction in size of calices and pelvis as result of chronic atrophic pyelonephritis.

The differential renal functional test probably offers the data of greatest clinical significance. The phenolsulphonphthalein return from the affected kidney is markedly less than normal, often only a faint trace, while from the normal kidney there is evidence of hypertrophied secretion. The contrast afforded by the marked unilateral diminution in renal function and the slight evidence of infection are the clinical data which might be regarded as pathognomonic of atrophic pyelonephritis (fig. 1).

The pyelogram also offers data which are often suggestive of atrophic pyelonephritis. As might be expected from the condition, the outline of the renal pelvis and calices is frequently much smaller than normal. When, however, there is a secondary dilatation of the renal pelvis and of the ureter the evidence of atrophy may become effaced. Dilatation of the ureter is occasionally noted, together with a contracted pelvic outline. In only a few cases was the outline of the pelvis in the pyelogram regarded as normal (fig. 2).

#### DIFFERENTIAL DIAGNOSIS

Atrophic pyelonephritis may be most easily confused with (1) reduplication of the renal pelves, (2) wide stricture of the lower ureter, and (3) chronic renal tuberculosis.

*Pelvic reduplication.* It has been demonstrated that the upper pelvis, with reduplication of the renal pelves, is usually about one-half the size of the lower pelvis. On cystoscopic examination it is very easy to overlook the second meatus, and if the inner ureter leading to the upper pelvis is catheterized the resulting pyelogram will demonstrate the outline of the small upper pelvis, which could easily be mistaken for an atrophic kidney (fig. 3).

*Stricture of the ureter.* With a wide stricture of the lower ureter there may be resulting atrophy of the kidney accompanied by a moderate degree of dilatation of the ureter and pelvis. The ureteral catheter may not meet with obstruction, and slight dilatation visible in the pyelo-ureterogram may be regarded as secondary.



FIG. 3. CASE 223011

Atrophic pelvis. Calices practically obliterated

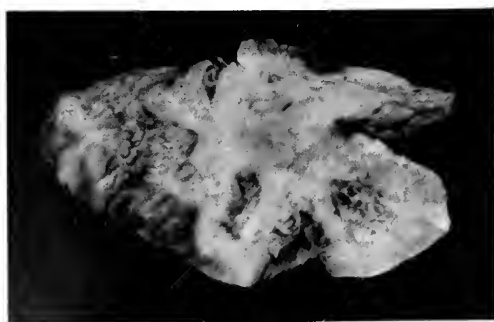


FIG. 4. CASE 216837

Atrophic pyelonephritis with almost complete fibrosis of kidney and kidney pelvis.



*Renal tuberculosis.* Renal tuberculosis of a chronic cicatricial type may have an insidious development, lacking any of the clinical data which are usually observed. The process then has a tendency to encapsulate; it slowly encroaches on the adjacent renal tissue, so that the kidney gradually atrophies and becomes largely cicatricial. The cystoscopic examination usually discloses evidence suggestive of tuberculosis, although the findings may make it indistinguishable from atrophic pyelonephritis. The demonstration of tuberculosis bacilli in the urine will of course identify the lesion. In one case the clinical course and the gross pathology of the kidney removed were those of atrophic pyelonephritis and it was only on microscopic examination of the renal tissue that tuberculosis was discovered.

*Bilateral pyelonephritis.* Occasionally a patient is observed with a definite chronic bilateral pyelonephritis with function of one kidney practically normal and that of the other greatly reduced. As a rule, however, the function of both kidneys is reduced symmetrically and surgical treatment is contra-indicated. If chronic infection is found in both kidneys and one kidney has become atrophic, the latter should be removed providing the function of the other kidney is normal or shows evidence of hypertrophy (fig. 4).

#### PATHOLOGY

The kidneys in this series of cases were small, averaging 58 grams in weight, and from 3 cm. to 5 cm. in their greatest diameter. They were firm and contracted, of much the same consistency as the fibrosed kidneys in arteriosclerosis. The outer surface is usually smooth and rounded instead of deeply scarred and granulated as in chronic nephritis. The capsule is thickened and strips easily. One half of the kidney may be involved more than the other, and in several cases the infection was apparently confined entirely to one pole, with hypertrophy of the tissue in the remaining portion of the kidney. In one patient a double kidney was found with complete reduplication of the pelvis and ureter. The atrophic pyelonephritis was confined entirely to the upper half, the lower half being quite normal. A deposit of

fat is sometimes found surrounding the renal pelvis, which is evidently the result of chronic perinephritis.

The tissues lining the kidney pelvis were greatly thickened, contracted and granular, often showing irregular folds as though shrunk to occupy a smaller space. In a few kidneys the pelvis showed evidence of a slight dilatation, although in the majority it had a capacity of only a few cubic centimeters. The ureters are generally thickened and dilated, especially in the upper third, and the uretero-pelvic juncture may be moderately occluded. On section irregular areas of condensed and fibrous tissue are seen. The cortex of the kidney in most cases is much thinner than normal, at times being only 2 to 3 mm. in depth. Occasionally the fibrosis and destruction of kidney substance were so marked that it was impossible to find the dividing line between the medulla and the cortex. Bands of fibrous tissue and thick walled blood vessels could be made out readily on the cut surface. Occasionally inflammatory cystic degeneration was found, especially in areas in which cicatricial changes were marked (fig. 5).

The microscopic examination showed a generalized atrophy of most of the functioning renal tissues together with a marked increase in the connective tissue elements. There were marked thickening and sclerosis of practically all the blood vessels. The intima especially was so thickened that at times it completely occluded the lumen of the vessel (fig. 6).

The tubules in most cases showed a general atrophy; at times there was a decrease in the number or even a complete absence in certain areas. The epithelial cells lining the tubules were flat and compressed. In some sections dilated lumina were found filled with pink staining colloid material, possibly the altered obstructed secretion of the tubular epithelium. Occasionally areas of normal or even hypertrophied tubules and glomeruli were found in close apposition to fields of complete fibrosis. Often areas of atrophied tubules with an excessive number of glomeruli were compressed together in the meshes of interlacing bands of fibrous tissue. This grouping of the glomeruli shows a generalized atrophy of the interstitial elements. The glomeruli, at times merely small hyaline areas, often formed the center

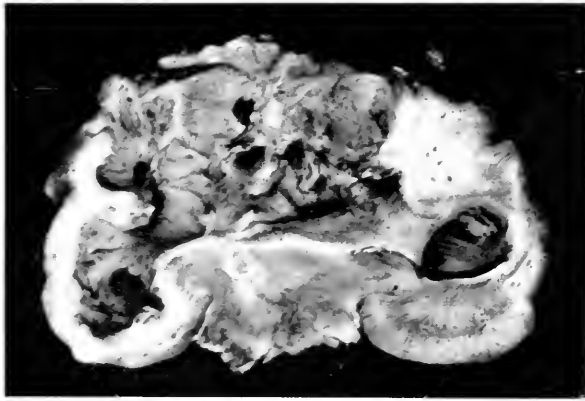


FIG. 5. CASE 298617

Atrophic pyelonephritis with destruction and fibrosis of most of the kidney substances.

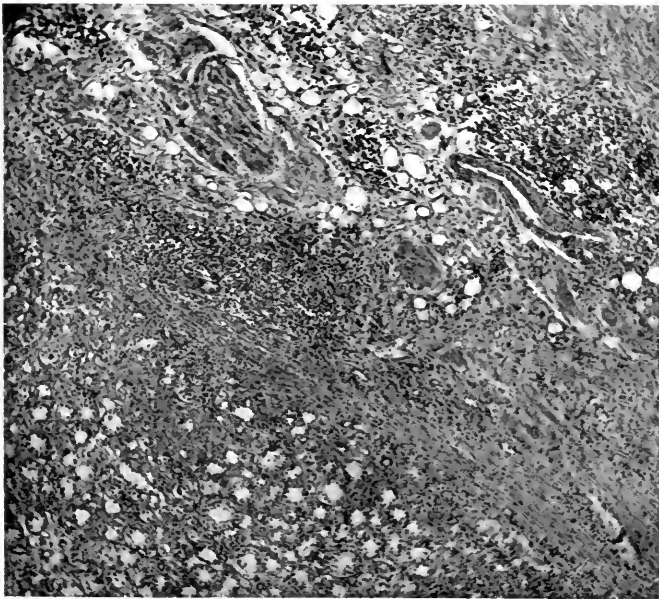


FIG. 6. CASE 142332

Atrophy and fibrosis with marked round cell infiltration

of a thick fibrous nodule. In one case a large hyaline mass was found, in the center of which was an extensive area of calcareous degeneration. Infiltration of small round cells was found in all sections. These cells, mononuclear lymphocytes and plasma cells, in some cases were quite extensively distributed, in others they were clumped and grouped, especially around hyalinized and fibrosed areas.

#### ETIOLOGY

The etiology offers a very interesting problem. It is quite evident that the condition is not the end result of the usual pyelonephritis. It can hardly be explained by primary stricture of the ureter with hydronephrosis and secondary atrophy since the dilatation of the pelvis is not great enough to cause atrophy, and, furthermore, the atrophy is not symmetric, but is frequently confined to one portion of the kidney. The possibility of a primary stricture of the ureter, with diffuse acute infection in the renal cortex and consequent atrophy, before the hydronephrotic sac is developed, may be considered. In cases of operations for perinephritic abscess or drainage of surgical kidneys it is possible that the renal atrophy was secondary, rather than primary.

It seems more probable that the atrophic condition is the result of a primary septic infarct. This is further borne out by the fact that the atrophy is at times confined to one portion of the kidney. The secondary dilatation of the pelvis and ureter may be explained either by a secondary stricture of the lower ureter or by an inflammatory atonic dilatation. The latter theory is supported by the fact that no evidence of ureteral obstruction is encountered, even by catheters of large caliber introduced into the dilated ureter.

#### RESULTS OF OPERATION

At operation it is often difficult to find the diseased kidney since it is often displaced and covered with fibrous tissue as a result of accompanying perinephritis. The kidney may be only 3 to 5 cm. in diameter and is easily overlooked. Although the small amount of tissue removed is out of proportion to the

severity of the patient's symptoms, nevertheless such symptoms disappear following removal of the kidney.

The results of operation for atrophic pyelonephritis have been very satisfactory. Improvement or cessation of vesical symptoms and improvement of the general condition have been accomplished for practically every patient.

Only three patients reported that evidence of urinary infection persisted, and only one of these claimed that there was no improvement. One patient was reported as having died from cause unknown three months after operation.



## OBSERVATIONS ON THE PHYSIOLOGY AND PATHOLOGY OF THE URETER<sup>1</sup>

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Though the function of the kidney in the production of urine, and that of the bladder in expelling it, are still objects of investigation and discussion by both laboratory workers and clinicians, the work done by the ureter in the transmission of urine is much less often considered. This is of course significant of the fact that the problems surrounding the ureter, both in health and disease, are much fewer in number and of less importance than those concerning the two organs which it connects. And still the ureter is by no means devoid of importance.

### PHYSIOLOGY

To summarize the present ideas on the physiology of this tube as brought out in the recent papers of Satani (1) in Baltimore, and those of Penfield (2) and O'Connor and Wislocki (3) in Boston, the ureter is a muscular tube which by peristaltic waves propels the urine from the kidney to the bladder. These waves vary in rate according to the varying diuretic activity of the kidney. The waves begin at the renal pelvis and pass downward to the bladder, to end in the opening of the uretero-vesical valve. They are initiated by an area of high metabolic rate in the renal pelvis and pass to one of lower rate below, in a manner quite analogous to intestinal peristalsis. Such an arrangement from a physical point of view is one admirably adapted to create and maintain a very low or even slightly negative pressure in the renal pelvis. For the increase in pressure on the contents of the tube which occurs just ahead of a wave, quickly gives

<sup>1</sup>Read at the meeting of the American Association of Genito-Urinary Surgeons, May 2 and 3, 1921, Richmond, Va.

way to a marked diminution of pressure, just behind one; and this lowering of pressure must act to withdraw more fluid from the calices. At the bladder end these pressure relations are maintained, under the usual physiological conditions, by the competence of the uretero-vesical valve, as an illustration of which fact I need only remind you of the impossibility in the cadaver of increasing the pressure within the bladder to a degree sufficient to propel fluid up the ureters.

In one important respect the ureteral peristalsis seems to differ from that of the intestine in that it does not show a reverse direction, or retroperistalsis. It has been noted, however, by all experimental workers on the ureter, that there occasionally occurs a reflux from the bladder to the kidney pelvis in either one or both ureters. This reflux has most often been seen in rabbits. The possibility of its occurrence in man has been denied by several writers, notably Sampson (4), although it is clearly evident that opportunity for careful study of the phenomenon under physiological conditions in man has been very infrequent. On the other hand Hagner (5) has reported two instances of reflux from the bladder upward around a ureteral catheter, and even more convincing evidence is brought forth by a series of cystograms made by Kretschmer (6) in 1916, in which the uretero-vesical valve was normal and free from the presence of an instrument, but in which, nevertheless, the opaque fluid entered the ureter from the bladder spontaneously. In experimental animals this reflux is found to depend but little on the degree of distension of the bladder, since it takes place at but a few millimeters of pressure as measured by the mercury manometer, and even this amount of intravesical pressure is not a constant one. It does depend directly, however, on the tonus or irritability of the bladder wall at the moment at which the reflux occurs. That it is in no sense a retroperistalsis can easily be determined by measuring the speed of the upward wave which has been estimated to be nearly three times quicker than the rate of an antiperistalsis wave caused by stimulation with barium chloride. As observed in a rabbit whose bladder contains a fluid colored by methylene-blue, it seems as though the bladder



detrusor muscle, being stimulated to contract at the moment the uretero-vesical valve happened to be open, suddenly ejects a column of blue fluid upward into each ureter as far as the kidney pelvis. To quote from the protocols of O'Connor and Wislocki:

While the ureters are under observation a column of blue fluid suddenly fills the lumen of the right ureter. A peristaltic wave which already left the renal pelvis meets the ascending column in the upper half of the ureter and impedes its progress. Fresh peristaltic waves commence above, becoming more frequent and vigorous and a struggle ensues for control of the ureter. The column of fluid advances towards the kidney and recedes again with each peristaltic wave. Gradually the peristaltic waves completely expel the methylene-blue solution from the ureter and the uretero-vesical orifice closes. The peristaltic waves quickly subside and resume their former frequency of one to two per minute. This phenomenon repeats itself in a few minutes on the same side and also in the left ureter.

Occasionally the ureters are unable to expel the invading fluid. The following instance illustrates this occurrence.

*Rabbit 4.* Male. November 10, 1919. After the initial procedures as described in the preceding experiment have been carried out a column of blue fluid is suddenly seen entering the right ureter. Vigorous peristaltic waves attempt to expel the fluid in the ureter, but after a few minutes it is observed that the ureter is becoming more and more distended with methylene-blue solution while the ureteral contractions are becoming feebler and feebler. Finally, the ureteral movements cease entirely and the invading fluid takes complete possession of the ureter and renal pelvis.

It is immediately evident that if a phenomenon analogous to this reflux should be proved to occur in man, the explanation of many of the problems of renal function as well as of renal infection will be much simplified.

#### PATHOLOGY

From a pathological viewpoint, the response of the ureter to two sorts of conditions is important; namely to those of obstruction on the one hand, and to infection on the other.

The response to obstruction of the ureter itself in its continuity is well known both experimentally and clinically. If the obstruction be complete the tube dilates to a point consistent with an intrarenal pressure of from 40 to 60 mm. Hg. less than that of the systolic blood pressure, at which point secretion from the kidney stops; and if the obstruction persists the organ slowly atrophies. Ureteral peristalsis is absent from an early date in the process. But if the obstruction be an incomplete or intermittent one, the ureter at first undergoes hypertrophy as well as dilatation, and experimentally the peristaltic waves are seen to be much increased in frequency and force. Under each of these conditions the tube increases in length as well as in size, and thus is produced the tortuous course with "S" shaped turns so familiar at the autopsy table.

Obstruction to the outflow of urine from the bladder, such as is produced by the hypertrophied prostate, congenital valves, or stricture of the urethra, may also be of significance in bringing about changes in the ureter, although the impediment is not located in the tube itself. These changes consist of hypertrophy and dilatation as in the previous case, but occurring at a much later date in the life history of the obstructing cause than where the ureter is itself involved or they may frequently be absent.

The response of the ureter to infection is always shown by dilatation of its lumen and loss of elasticity of its walls. According to the degree of infiltration by inflammatory products the wall may be found thickened to a greater or less degree. For instance, in infection by the tubercle bacillus the ureter is often seen to be eight or ten times larger than normal, but on section this increase in size is seen to consist almost wholly of increase in the thickness of the wall with but moderate increase in the lumen. Non-tubercular infection, on the other hand, may cause an equally large ureter with but little change in the thickness of the wall. It is important to note the fact that such dilatation frequently occurs in the entire absence of any form of mechanical obstruction.

The integrity of the uretero-vesical valve is lost much earlier in the presence of infection than it is in cases of obstruction

only, and it is only in the presence of severe infection that such marked changes as those expressed by the term "golf-hole orifice," are seen.

Clinically, at operation or at autopsy, the alterations found existing in the ureter are most often to be ascribed to the combined effect of both obstruction and infection, and since both



FIG. 1

causes act in a measure to produce similar results it is not always possible to form an accurate judgment as to the individual influence of each. Cases in which only one of these factors has been operative are not rare, however, of which the following may serve as types:

*Case 1.* Infection only. A single woman of twenty-one years entered the Peter Bent Brigham Hospital February 21, 1920, complaining of back ache.

Her general health has never been good. She has suffered from frequent tonsillitis until ten years ago when the tonsils were removed, and also from many headaches associated with nausea and vomiting.

Three years ago she had an attack of pain which was first thought to be appendicitis but, on examination at the Boston City Hospital, both



FIG. 2

kidneys were found infected and the ureters seen to be dilated. Though examination of the urine failed to find tubercle bacilli, no further

diagnosis was made. As a child she had dysuria, and she has always had nocturia, two or three times. Since the age of four she has had a "slimy urine," for which she has received medication off and on. Since three years ago she has had pain in the back, especially in the left lumbar region. Eleven months ago she had "influenza," and shortly after this tubercle bacilli were found in the sputum. This was followed by fever and three months later a pleurisy developed.

Examination showed bilateral pulmonary tuberculosis and a turbid urine in which there were no tubercle bacilli on guinea pig inoculation. The phthalein output was only 10 per cent in two hours, and there was a blood urea nitrogen of 57 mgm. in 100 cc.

Here we have a history of chronic infection of the urinary passages extending over years. On filling the bladder with opaque solution by catheter, the fluid entered the enormously dilated ureters readily (figs. 1 and 2).

*Case 2. Infection only.* A girl of seventeen entered the Peter Bent Brigham Hospital on October 11, 1918, unconscious and with fever. A diagnosis was made of cerebro-spinal meningitis of the epidemic type. Thirty-six days later, after seven or eight injections of anti-meningococcus serum, she was discharged cured of all signs of meningitis, but there remained a gangrenous cystitis with deep, extensive ulceration of the bladder. The urine had contained pus since entrance, and on culture showed the colon bacillus.

Examination by cystoscope showed that each ureteral orifice was dilated, and on cystogram fluid passed readily upward into each renal pelvis (fig. 3).

*Case 3. Obstruction only.* The specimen illustrated here was found at an autopsy made by Dr. S. B. Wolbach at the Children's Hospital, on a baby somewhat less than a year old. There was no sign of infection in the urinary tract, but because of congenital incomplete stricture of each ureter at its entrance into the bladder, very extensive hydroureter and hydronephrosis took place. These results are in all respects analogous to those where an incomplete obstruction is caused experimentally (fig. 4).

#### THE URETER IN PROSTATIC OBSTRUCTION

These being the general facts of the physiology and pathology of the ureter, it is of interest to consider their especial applica-

tion to the condition of prostatic obstruction. To gain an idea of the clinical condition of the bladder and ureteral orifices in



FIG. 3

such cases, I have reviewed 150 histories of patients examined and operated upon in my clinic at the Peter Bent Brigham Hospital. In the first place it is of interest to find that of this number only

34 were free from infection of the bladder urine on entrance to the hospital. There are notes on the cystoscopic appearances of the ureteral orifices in 29 of this group of uninfected cases, and in all they appeared to function normally and to be free from edema or other distortion. In five instances either it was not possible to see the orifices because of the size of the hypertrophied gland, or cystoscopy was not done.

No further attempt than observation by cystoscope was made to investigate the condition of the ureters in this group of uninfected cases. It may be objected, therefore, that such observation of the uretero-vesical valve is not a sufficiently accurate method to establish its functional integrity, and also that it reveals nothing in regard to the ureter itself. This objection which is sound in a measure at least, I have tried to meet in part by autopsy records of cases with clean but obstructed bladder, who died from causes other than those present in the urinary tract. Such cases are not very common, but the findings in them, as far as I have investigated the question, all bear out the point that in the absence of infection, obstruction by the prostate does not carry as a necessary consequence any abnormality of the ureters. Two such autopsy records are as follows:

*Case 4.* A man, aged seventy-two entered the Peter Bent Brigham Hospital on March 19, 1921, in an irrational condition, with a high fever due to broncho-pneumonia and lymphangitis of the leg. He had suffered for two years from a varicose ulcer of the leg, with much edema of both legs, for which he was given digitalis in the Medical Out Door Department. At entrance to the hospital it was impossible to get a detailed history because of his mental condition. He was continuously incontinent of urine so that this was not examined.

At autopsy the right kidney weighed 250 grams; the left 190 grams. Their capsule was not adherent. Both pelves and ureters were normal. The bladder was small and contracted, and without any evidence of infection. The prostate formed an enlarged spherical mass 6 cm. in diameter, obstructing the vesical outlet. On microscopic examination the kidneys showed chronic pyelonephritis and arteriosclerosis.

*Case 5.* A single man, aged seventy-four; entered the Peter Bent Brigham Hospital March 19, 1919, complaining of bronchial trouble,

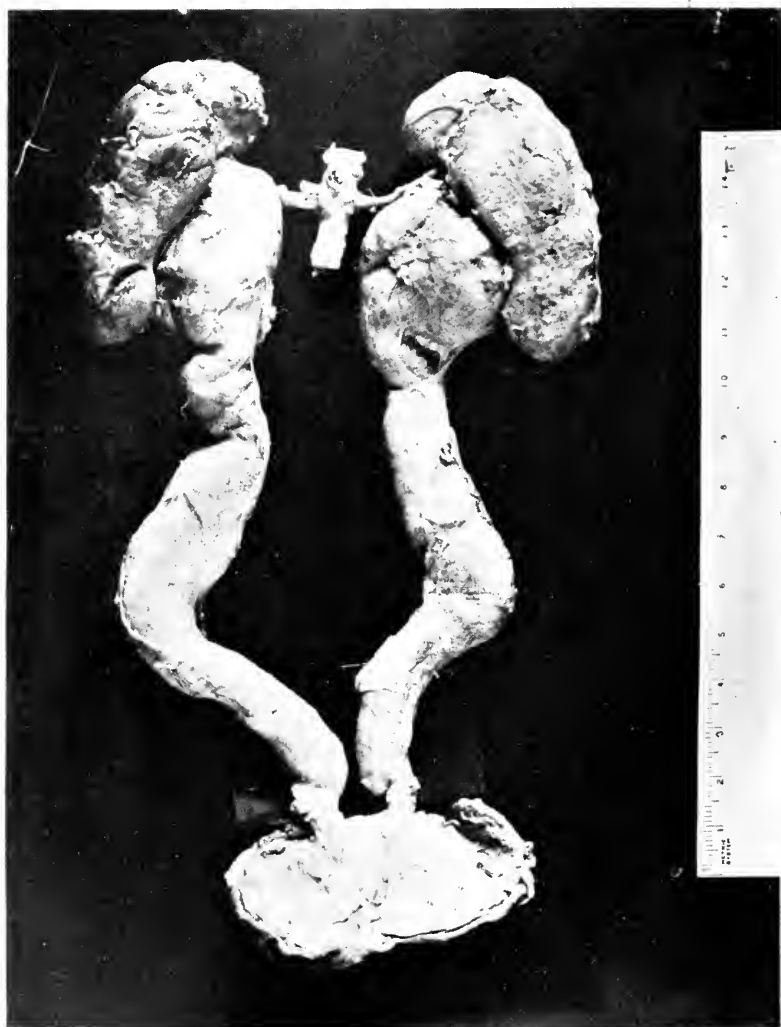


FIG. 4

and died five days later of broncho-pneumonia. For ten years he had had nocturnal frequency, but no retention. The phthalein test showed about 10 per cent. The urine was free from pus.



At autopsy the bladder was distended with about 500 cc. of urine, and the prostate was enlarged in all its lobes, to about 5 cm. in diameter. The ureters were normal in all respects. The kidneys showed chronic nephritis.

We have here then cases illustrative of the fact that an obstruction may be caused by the prostate which is accompanied by extreme degrees of renal damage and still the ureters remain normal. Such evidence leads strongly to the conclusion that whatever may be the fate of the ureter or of its valvular opening after infection has supervened, there is either no change in its histology or at most only moderate hypertrophy in clean cases.

As regards the group of infected cases, evidence also exists that in some of these, too, there is but little change in the ureters. But in other instances of longer duration or of greater severity of infection, profound alteration with dilatation of the tube and destruction of its valvular opening are well known to occur.

In all the many studies on the mechanism of prostatic hypertrophy, one meets frequently with a statement that in such conditions renal function is impaired and permanent pathological changes are brought on by so-called "back pressure" from the bladder to the kidney. It is pointed out that the kidneys are continuously compelled to do their work at a disadvantage, and it is inferred, at least, that this consists in an abnormally high intra-pelvic and intra-ureteral pressure. When there exists obstruction at the outlet of the bladder, this organ must contract more forcefully than is normal at each urination to expel the contents, and the inference is that this increased intravesical pressure is propagated to the kidneys. It is a fact, of course, that a suprapubic opening of the bladder or an indwelling catheter will relieve this condition, and be followed by improvement in the renal function which is often strikingly marked. Such procedures are variously referred to as "relieving the back pressure on the kidney," or as "renal decompression."

The fact that such a result follows procedures which put the bladder out of action is undoubted; the conditions which exist previous to the institution of such suprapubic opening are far

from clear, however. How can there be any "back pressure," in a physical sense, on a kidney whose ureter is normal anatomically, and the ureterovesical valve of which is apparently competent? For I am sure that you will agree both from your own experience, as well as from the evidence which I have just discussed, that a degree of prostatic obstruction sometimes amounting to complete retention of urine, often occurs in which there is serious and easily demonstrable renal damage, but in which the ureters and their openings into the bladder are normal.

I can see no better way of explaining these conditions which we know to exist, than by assuming the existence in man of the reflux of urine from the bladder upward into the ureters, which we have noted as happening experimentally in animals. As we have already seen, the conditions surrounding the occurrence of this reflux are as yet quite imperfectly understood. Whether it occurs habitually in man, either under normal or pathological conditions, is not at all clear; and I am not in a position at present to do more than suggest to you the changes in our views on the mechanism of prostatic obstruction, which the assumption of such an upward reflux from the bladder would bring about. We are continuing the study of this subject both in the clinic and in the laboratory, and hope at a later date to bring before you more details concerning this most interesting phenomenon.

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# CONCERNING THE EFFECT OF SALINE PURGATIVES ON THE ABSORPTION AND EXCRETION OF PHENOLSULPHONPHTHALEIN

## A PRELIMINARY COMMUNICATION

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### INTRODUCTORY

While suffering from an attack of the grippe, the writer took for the relief of a severe headache a full dose of aspirin which generally proved efficient for headache on other occasions. In the present instance no relief was experienced. The writer then swallowed a tablet of phenacetin and salol, also without much relief. This was followed by 5 grains of pyramidon and the last drug also proved inefficient in the relief of the headache and pains. On reflecting over the action of the above drugs the author recalled that previously to the taking of the antipyretics he had taken a saline purgative. It therefore, occurred to him that possibly the saline purgative might have played a part in the prevention or retardation of the absorption of the drugs which were taken subsequently to it. This clinical experience suggested to the author an investigation on the question of whether the saline purgatives have an influence on the absorption of other drugs when taken by mouth. An extensive investigation along these lines was therefore undertaken. One of the most convenient drugs for this purpose was thought to be phenolsulphonphthalein. Accordingly this drug was administered to several dogs with a given quantity of water by the stomach tube. At the end of two and one half hours the dogs were catheterized and the amount of phenolsulphonphthalein excreted by the kidneys was determined colorimetrically. Inasmuch

as phenolsulphonphthalein is excreted almost entirely by the kidneys, irrespective of the channel of its administration, the above examination of the urine was a reliable indication of the rapidity of absorption and excretion of the drugs. A few days later the same animals were given exactly the same amount of phenolsulphonphthalein in exactly the same amount of water as in the previous experiment, but on this occasion there was dissolved in the water a good dose of sodium sulphate. The fluid plus the dye and sodium sulphate were administered by stomach as before and the dogs were again catheterized at the expiration of the same period of time, namely two and one-half hours. It was found that the amount of dye in the urine was less than one-half of the amount excreted in the previous or control experiments.

The same procedure was repeated some days later on the same dogs with a solution of magnesium sulphate and in this case again the amount of dye excreted at the end of two and one half hours was found to be about one-half of that excreted normally when plain water had been administered without a saline purgative. It was evident therefore that the administration of magnesium sulphate and sodium sulphate by mouth tended to retard the absorption and hence the excretion of phenolsulphonphthalein in the dogs.

*Series 1. Phenolsulphonphthalein by mouth with and without magnesium sulphate (50 cc. of 10 per cent solution plus 50 cc. water)*

*Experiment 1.* Pedro (20 kilo). Normal output at end of two and one-half hours is about twice as great as with saline.

*Experiment 2.* Brown (15 kilo). Normal output at end of two and one-half hours is about twice as great as with saline.

*Experiment 3.* L. W. (10 kilo). Normal output at end of two and one-half hours is about twice as great as with saline.

*Series 2. Phenolsulphonphthalein by mouth with and without sodium sulphate (50 cc. of 15 per cent solution plus 50 cc. water)*

*Experiment 1.* Pedro (20 kilo). Normal output 3 times as great as after saline.

*Experiment 2.* Brown (15 kilo). Normal output 3 times as great as after saline.

*Experiment 3.* L. W. (10 kilo). Normal output 3 times as great as after saline.

#### INTRAMUSCULAR INJECTIONS

It was then thought possible, though by no means probable, that perhaps the administration of saline purgatives by stomach might exert some effect on the excretion of phenolsulphonphthalein even when the dye was given by injection. Accordingly, to settle this point, experiments were made on some rabbits. The usual kidney function test was performed on two rabbits by injecting them with 1 cc. of phenolsulphonphthalein each intramuscularly. The urine was then collected at the end of the first hour and at the end of the second hour and the amount of dye excreted was determined by the usual procedures. A few days later the same animals were again injected with 1 cc. of phenolsulphonphthalein each intramuscularly and simultaneously with the injection there was introduced by stomach tube about 50 cc. of water, containing a moderate dose of magnesium sulphate. The output of the dye was again determined at the end of the first and second hours and it was found that the excretion of phenolsulphonphthalein was markedly delayed in the experiments in which the salines were administered by stomach. Precisely similar results were obtained with sodium sulphate.

#### *Series 3. Injection of dye in rabbits*

*Experiment 1.* Injections of phenolsulphonphthalein 1 cc. intramuscularly.

Rabbit A.	Output at end of first hour. . . . 40%	} Total 70%
Rabbit A.	Output at end of second hour. . . 30%	
Rabbit B.	Output at end of first hour. . . . 40%	} Total 70%
Rabbit B.	Output at end of second hour. . . 30%	

*Experiment 2.* Injections of phenolsulphonphthalein 1 cc. intramuscularly and 25 cc. of  $\text{MgSO}_4$  (10 per cent) plus 25 cc. water by stomach tube.

Rabbit A.	Output at end of first hour . . .	20%	} Total 30%
Rabbit A.	Output at end of second hour . .	10%	
Rabbit B.	Output at end of first hour . . .	35%	} Total 43%
Rabbit B.	Output at end of second hour . .	8%	

*Series 4*

*Experiment 1.* Injections of phenolsulphonphthalein 1 cc. intramuscularly.

Rabbit C.	Output at end of first hour . . .	50%	} Total 70%
Rabbit C.	Output at end of second hour . .	20%	
Rabbit D.	Output at end of first hour . . .	10%	} Total 90%
Rabbit D.	Output at end of second hour . .	80%	

*Experiment 2.* Injections of phenolsulphonphthalein 1 cc. intramuscularly and 15 cc.  $\text{Na}_2\text{SO}_4$  (10 per cent) plus 25 cc. water by stomach tube.

Rabbit C.	Output at end of first hour . . .	25%	} Total 40%
Rabbit C.	Output at end of second hour . .	15%	
Rabbit D.	Output at end of first hour . . .	53%	} Total 16%
Rabbit D.	Output at end of second hour . .	12%	

Following the experiments on the rabbits, the same kind of experiments were performed on three dogs. Phenolsulphonphthalein was first injected intramuscularly and the kidney function of the dogs was determined by measuring the dye output at the end of the first and second hours. A few days later the same dogs were given the same amount of dye by injection, but previous to the injection each dog received by stomach tube a quantity of sodium sulphate. It was found that in the latter series of experiments there was a distinct diminution in the phenolsulphonphthalein output. Following these experiments some days later another normal kidney function test was performed on the same animals and two days later the same animals were injected with the dye and magnesium sulphate was administered by stomach tube. In this case also the phenolsulphonphthalein output was diminished or retarded by the administration of the salines. From the above preliminary experiments it would therefore seem that the administration of saline purgatives by stomach tends to retard the excretion of phenolsulphonphthalein, not only when given by mouth but also after injection of the drug.

*Series 5. Dogs injected with phenolsulphonphthalein 1 cc. intramuscularly with and without sodium sulphate 20 per cent by stomach tube (50 cc.)*

Normal

*Experiment 1. Pedro (20 kilo).*

Output at end of first hour.....	45%	} Total 60%
Output at end of second hour.....	15%	

*Experiment 2. Brown (15 kilo).*

Output at end of first hour.....	45%	} Total 70%
Output at end of second hour.....	25%	

*Experiment 3. L. W. (10 kilo).*

Output at end of first hour.....	50%	} Total 70%
Output at end of second hour.....	20%	

With sodium sulphate

*Experiment 1. Pedro (20 kilo).*

Output at end of first hour.....	40%	} Total 45%
Output at end of second hour.....	5%	

*Experiment 2. Brown (15 kilo).*

Output at end of first hour.....	40%	} Total 50%
Output at end of second hour.....	10%	

*Experiment 3. L. W. (10 kilo).*

Output at end of first hour.....	35%	} Total 45%
Output at end of second hour.....	10%	

*Series 6. Dogs injected with phenolsulphonphthalein 1 cc. intramuscularly with and without magnesium sulphate (100 cc. of 10 per cent solution) by stomach tube*

Normal

*Experiment 1. Pedro (20 kilo).*

Output at end of first hour.....	45%	} Total 60%
Output at end of second hour.....	15%	

*Experiment 2. Brown (15 kilo).*

Output at end of first hour.....	50%	} Total 70%
Output at end of second hour.....	20%	

*Experiment 3. L. W. (10 kilo).*

Output at end of first hour.....	50%	} Total 65%
Output at end of second hour.....	15%	

## With magnesium sulphate

*Experiment 1.* Pedro (20 kilo).

Output at end of first hour.....	35%	} Total 45%
Output at end of second hour.....	10%	

*Experiment 2.* Brown (15 kilo).

Output at end of first hour.....	30%	} Total 50%
Output at end of second hour.....	20%	

*Experiment 3.* L. W. (10 kilo).

Output at end of first hour.....	10%	} Total 40%
Output at end of second hour.....	30%	

## EXPERIMENTS ON INTESTINAL LOOPS

In order to analyze the above phenomena more in detail the following experiment was performed. A cat was anesthetized with ether, a laparotomy was made and the small intestines exposed.

Two loops of the jejunum, each 25 cm. long were tied off, leaving the vascular supply intact. Into one of the loops there was injected 10 cc. of solution of sodium sulphate (10 per cent) plus 1 cc. of phenolsulphonphthalein. The abdominal wound was closed and the animal put in a cage. At the end of one hour the cat was killed with ether, the abdomen was opened again and the two loops of the intestine examined. It was evident at once that one of the loops was greatly distended, like a sausage, while the other loop was collapsed. The two loops were excised and the fluid contents of each were measured. In the control loop, into which 10 cc. of water had been injected there were found only 1 or 2 cc. of intestinal juice, while in the other loop, the one with the saline solution, the volume of the fluid had increased to over 30 cc. Each loop of the intestine was washed out with water and the washings combined with the fluid contents already obtained and the amount of dye present in the intestinal loop was determined. It was found that while in the control over 50 per cent of the phenolsulphonphthalein had been absorbed by the intestine at the end of one hour, in the second loop there was present over 90 per cent of the dye. It was thus evident that the sodium sulphate retarded markedly the absorption



of the phenolsulphonphthalein from the intestinal lumen. This difference in absorption between the two loops was further strikingly corroborated by immersing each loop separately in weak alkali. On treatment with alkali the mucosa of the normal loop became intensely red in color, showing that the dye had penetrated inside the cells. On the other hand the second loop showed very little pink discoloration, thus indicating that very little of the dye had been absorbed. On extracting each intestinal segment with alcohol, the phenolsulphonphthalein was dissolved in the alcohol, and a much greater amount of dye was obtained from the control loop. Several such experiments were performed with similar results.

*Series 7*

*Experiment 1.* Cat, ether anesthesia, Abdominal incision.

A. Intestinal loop 25 cm. long is tied off at each end and injected with 10 cc. water and 1 cc. phenolsulphonphthalein.

B. Intestinal loop 25 cm. long is tied off at each end and injected with 10 cc. of 10 per cent sodium sulphate solution and 1 cc. phenolsulphonphthalein.

Abdomen is closed. At end of hour animal is killed and the two loops are removed.

Volume of contents of loop A is 2 or 3 cc. Loop is washed and washings plus contents show phthalein-100 per cent. On dipping loop A (after rinsing) in alkaline water, mucosa shows deep red color. On dipping loop B (after rinsing) in alkaline water, mucosa shows very little pink color.

OBSERVATIONS ON MAN

Inasmuch as the phenolsulphonphthalein test is a perfectly harmless one and inasmuch as saline purgatives can be taken with impunity by almost everyone, a number of tests were made to determine whether the above experimental findings in animals applied to man. Accordingly a number of observations were made on the author himself and some of his colleagues and friends with their cheerful consent and understanding. The following protocols show the results obtained.

*Series 8*

*Observation 1.* Dr. E. M. K. G. April 15. Kidney function test. Injected 1 cc. of phenolsulphonphthalein in upper arm intramuscularly.

Output at end of first hour.....35%	} Total 60%
Output at end of second hour.....25%	

April 20. Kidney function test same as above.

Output at end of first hour.....35%	} Total 60%
Output at end of second hour.....5%3	

April 21. At 1:10 p.m. subject drinks about 40 grams of Epsom salts in 250 cc. of water; then eats lunch and drinks tea. 2:00 p.m. injects 1 cc. of phenolsulphonphthalein in deltoid muscle.

Output at end of first hour.....5%	} Total 33%
Output at end of second hour.....28%	

*Observation 2.* Dr. E. M. K. G.

Normal phthalein output first hour.....35%	} Total 60%
Normal phthalein output second hour.....25%	

Subject was given 10 grams of sodium phosphate and phthalein injected again 15 minutes later. No purgation occurred within two hours.

Phthalein output at end of first hour.....25%	} Total 45%
Phthalein output at end of second hour....20%	

*Observation 3.* Dr. D. I. M.

Normal phthalein output at end of first hour...45%	} Total 65%
Normal phthalein output at end of second hour.20%	

Same subject was injected with phthalein thirty minutes after taking 1½ Seidlitz powders.

Output of phthalein at end of first hour...15%	} Total 40%
Output of phthalein at end of second hour.25%	

There was one movement between first and second hours, but no urine lost.

*Observation 4.* Mr. C. M.

Normal phthalein output at end of first hour...50%	} Total 75%
Normal phthalein output at end of second hour.25%	

Same subject was given function test immediately after administration of 15 grams of magnesium sulphate.

Output of phthalein output at end of first hour...40%	} Total 60%
Output of phthalein output at end of second hour.20%	

*Observation 5.* Mr. C. Z. G.

Normal output at end of first hour.....45%	} Total 65%
Normal output at end of second hour.....20%	

Same subject was injected with phenolsulphonphthalein immediately after administration of 15 grams of sodium sulphate.

Output of phthalein at end of first hour...30%	} Total 50%
Output of phthalein at end of second hour...20%	

*Observation 6.* Mr. D. V. H.

Normal output at end of first hour.....45%	} Total 70%
Normal output at end of second hour.....25%	

Patient was administered  $\frac{1}{2}$  ounce magnesium sulphate. Injected immediately after with phenolsulphonphthalein.

Output at end of first hour.....30%	} Total 50%
Output at end of second hour.....20%	

*Observation 7.* Mr. J. S. Chronic nephritis, hypertension, myocarditis.

Normal output at end of first hour.....27%	} Total 47%
Normal output at end of second hour....20%	

Same subject was administered 15 grams of sodium sulphate and simultaneously given an injection of phenolsulphonphthalein.

Output at end of first hour.....20%	} Total 30%
Output at end of second hour.....10%	

*Observation 8.* Mr. D. M. Hypertension and chronic nephritis.

Normal phthalein output at end of first hour..30%	} Total 55%
Normal phthalein output at end of second hour...25%	

Same subject was given phthalein test thirty minutes after drinking 75 to 100 cc. of "Pluto Water."

Output of phthalein at end of first hour...10%	} Total 40%
Output of phthalein at end of second hour...30%	

*Observation 9.* Mr. C. Z. G.

Normal output of phthalein first hour.....45%	} Total 70%
Normal output of phthalein second hour...25%	

Patient was given half an ounce of sodium sulphate one hour before injection.

Phthalein output first hour.....27%	} Total 42%
Phthalein output second hour.....15%	

*Observation 10.* Mrs. B.

Normal output of phthalein at the end of two hours....57%

Patient was given two ounces of magnesium sulphate one hour before injection.

Total output two hours after injection.....47%

In all of the above clinical observations no restriction was put on the subject's intake of fluid by mouth. Indeed, in most of the cases the subject took lunch and drank water or tea after the administration of the saline purgative. It will be noted that in every case some delay in excretion of phenolsulphonphthalein resulted. This was more marked in some of the subjects than in others, and as might be expected the delay in excretion was greater when the dye was injected not simultaneously with the administration of the salines, but some time later, inasmuch as in such cases the salines had more time to exert their osmotic effect. While the above observations on men are but few in number and are not sufficient to establish definitely as a general rule a delay in the excretion of phenolsulphonphthalien produced by saline purgatives in all clinical cases, the results nevertheless so far obtained are significant, and render a more extensive clinical study on the subject very desirable.

#### DISCUSSION

While the extensive studies of kidney function with the aid of phenolsulphonphthalein by Rowntree, Geraghty, (1) Fitz (2) and others have included a consideration of a great many factors such as experimental kidney lesions, chronic passive congestion of the kidney, the effect of diuretics, etc., the influence of purgatives on the test has apparently not received any serious attention anywhere in the literature on this subject. From the above described experiments it is evident that the administration of saline purgatives by mouth influences markedly the excretion of the dye at least in animal experiments. The occurrence of such a delay after the introduction of phenolsulphonphthalein through the stomach tube is perhaps not surprising and is proved experimentally by the experiments with the intestinal loops. That such a delay in excretion of the dye, however, should occur also after intramuscular injections is more remarkable and surprising. What the exact mechanism is, playing the rôle in the relationship between the saline and the dye, is not quite clear. Undoubtedly however, osmotic phenomena and an increased concentration of the blood play the principal part; for it is known

that after full doses of saline purgatives the erythrocyte blood count is considerably increased. A priori however, a delay in excretion such as has been obtained in the above experiments was not expected.

Braasch and Kendall (3) have recently emphasized the value of intravenous injections of phenolsulphonphthalein in testing kidney function. The dye in such cases is, of course, very rapidly excreted so that the greater percentage of it can be detected in the urine one hour after injection. It was interesting to inquire whether the saline purgatives when given by mouth would exert any influence on the excretion of the phenolsulphonphthalein; after the administration of the dye by intravenous injection. Although a delay of the dye excretion in such a case would hardly be expected owing to the very rapid elimination of the drug, nevertheless several experiments on dogs were performed to settle this question. The following is a brief résumé of these experiments:

*Series 9*

*Experiment 1.* Large brown dog with slight kidney impairment produced by repeated injections of cantharidin. Normal excretion after intravenous injection of 1 cc. of phenolsulphonphthalein at the end of one hour, 60 per cent. Excretion of phenolsulphonphthalein at the end of one hour after injection of 250 cc. of a 10 per cent solution of sodium sulphate, 25 per cent.

*Experiment 2.* Brown dog. Normal excretion after intravenous injection of 1 cc. of phenolsulphonphthalein after one hour, 70 per cent. Excretion after previous administration of 250 cc. of 10 per cent sodium sulphate solution, 45 per cent.

*Experiment 3.* Small white dog. Normal excretion after intravenous injection of 1 cc. of phenolsulphonphthalein after one hour, 70 per cent. Excretion after previous administration of 250 cc. of 10 per cent solution of sodium sulphate, 50 per cent.

*Experiment 4.* Large white and brown dog. Normal excretion after intravenous injection of 1 cc. of phenolsulphonphthalein after one hour, 70 per cent. Excretion after previous administration of 250 cc. of 10 per cent solution of sodium sulphate, 50 per cent.

*Experiment 5.* Small white dog. Normal excretion after intravenous injection of 1 cc. of phenolsulphonphthalein after one hour,

70 per cent. Excretion after 100 cc. of 10 per cent magnesium sulphate solution, 60 per cent.

*Experiment 6.* Brown dog. Normal excretion after intravenous injection of 1 cc. of phenolsulphonphthalein after one hour, 70 per cent. Excretion after 100 cc. of 10 per cent solution of magnesium sulphate, 50 per cent.

It thus appears that even after intravenous injections there was some delay in the rate of excretion of phenolsulphonphthalein produced by the previous administration of saline purgatives.

The results of the above animal experiments together with the few observations on men demand a more extensive clinical study of the effects of saline purgatives on the rate of excretion of phenolsulphonphthalein, for the subject is of practical importance. It would seem of vital importance not to administer saline purgatives simultaneously with or a short time before the injection of phenolsulphonphthalein for the performance of kidney function tests. This is perhaps to be emphasized in view of the routine practice in some institutions of purging patients with salines as a preliminary to surgical operations. Furthermore the effect exerted by salines in depleting the tissues of fluid might possibly, in view of the above observations, play an important rôle in regard to the redistribution and excretion of various toxins.

Whether other purgatives than the saline cathartics delay the excretion of phenolsulphonphthalein has not yet been determined, although some experiments are already in progress on this subject. It may be stated in this place that a few experiments with calomel introduced into intestinal loops of cats showed that this drug does not retard the absorption of phthalein in the same way as the saline purgatives. An extensive investigation has been begun and is in progress by the author concerning the influence of various purgatives, and more particularly saline purgatives, on the absorption from the stomach and intestines of a series of important drugs, such as the antipyretics, digitalis, etc.

## CONCLUSIONS

1. The excretion of phenolsulphonphthalein by the kidneys after its administration through the stomach tube in animals is delayed by the previous administration of saline purgatives in the same animal.

2. The administration of saline purgatives through the stomach tube in animals produces also a delay in the excretion of phenolsulphonphthalein even after injections of that drug.

3. The above observations on animals have been confirmed also on a few human subjects and therefore invite a more extensive clinical investigation concerning the influence of saline purgatives on the excretion of phenolsulphonphthalein.

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## PNEUMOPYELOGRAPHY

### A PRELIMINARY REPORT ON ITS ADVANTAGES AND TECHNIQUE

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Since the introduction of the method of injecting oxygen, and later, carbon dioxide and even air, into the various body cavities as an aid in X-ray diagnosis, its use has become comparatively common and varied; however, up to the present time, the injection of gas into the renal pelvis for Rentgenological purposes has not been popularized to the extent which it deserves, and the object of this paper is to increase the popularity of pneumopyelography, the technique of which is simple and the advantages numerous.

In reviewing the literature of this subject only one article has been found which was written by Dr. L. G. Cole of New York City in 1910.<sup>1</sup> In this article Dr. Cole describes a unique method of inflating the kidneys with warm filtered air, and mentions some of the radiographic advantages of such a procedure over ordinary pyelography. Since that time, so far as we are able to ascertain and for no apparent reason, the procedure has been abandoned.

Bringing the renal pelvis and calices into relief by the instillation of some opaque media for X-ray purposes has been in vogue for a number of years. Among the opaque solutions which have been used are: collargol, argyrol, potassium iodide, pyelon, sodium bromide, sodium iodide, and thorium nitrate, some of which are exceedingly toxic. The essential requisites of an opaque solution are that it shall be first, non-toxic, second, non-irritating.

<sup>1</sup>Lewis Gregory Cole, Radiography of the kidneys inflated with air or gas. Amer. Jour. of Dermatology and Genito-Urinary Diseases, 1910.

Sodium bromide and sodium iodide are the least toxic of the above named solutions, being practically innocuous when injected into the blood stream. However it has been shown that the effect of the toxic and the non-toxic solutions on the kidney tissue differs very little.

When the ureter or pelvis has been filled with an opaque solution and a Rentgenogram obtained, it causes a white shadow on the X-ray plate, bringing into relief only the pelvis and calices and not the kidney tissue itself, as the shadow is so dense that it obscures the tissues causing lighter shadows directly in front or behind the opaque media. For instance, the shadow of a stone in the ureter, pelvis or calix is obscured by the heavier shadow of the opaque solution.

The injection of oxygen into the ureter or renal pelvis causes no shadow at all, but creates a space which shows up black on the X-ray plate, and brings into relief not only the pelvis and calices, but also the kidney tissue, as it does not obscure the shadows caused by the tissues either in front or behind. For instance, the shadow of a stone in the ureter, pelvis or calix will not be obscured by the oxygen and the size, shape and position of the stone can be easily determined.

The black of the oxygen against the lighter shadow of the kidney substance makes a better contrast for the study of the kidney tissue itself than does the white shadow of the opaque solution against the surrounding lighter shadow of the kidney.

So far in our group of cases only oxygen had been used in pneumopyelography which meets fully the requirements of a contrasting media, in that it is not toxic and not irritating and may even be beneficial in some cases.

As oxygen is more permeable than any of the opaque solutions, it will pass obstructions or constrictions more readily than the solutions.

Pneumopyelography is perhaps most advantageous in the following groups of cases:

1. Stone in the ureter, pelvis or calices, as the size, shape, and position of the stone can be determined; and, at the same time, the ureter, pelvis and calices are brought into relief.

2. Hydronephrosis.

3. Pyonephrosis.

4. Strictures or obstructions of the ureter which cannot be readily passed by the opaque solutions.

5. Malformed and malplaced kidneys such as a horseshoe kidney lying across the spinal column, in which the pelvis, when injected with an opaque solution, cannot be clearly differentiated from the vertebra.

The apparatus required for the oxygen injections (fig. 1) includes an oxygen tank, about three feet of rubber tubing in the center of which is a tube connected to a manometer, 2 cc. Luer

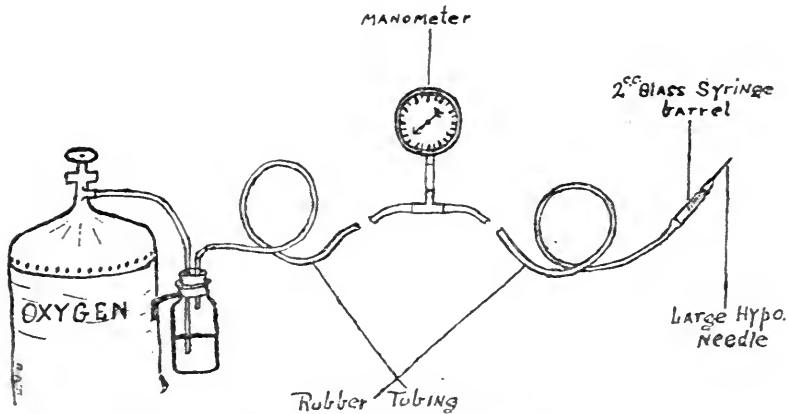


FIG. 1. THE APPARATUS USED IN PNEUMOPYELOGRAPHY

syringe barrel, a hypodermic needle, large enough to fit snugly in the end of a no. 6 French ureteral catheter, and a non-opaque no. 6 ureteral catheter.

The procedure consists in the preparation of the patient and the injection of the oxygen.

The preparation of the patient determines to a large extent the accuracy with which the plate can be interpreted, as gas in the intestines overlying the kidney may partially obscure or be confused with the outline of the oxygen within the pelvis and calices. Two ounces of castor oil is administered the night before; a soap sud enema is given six hours previous and repeated two hours previous to the X-ray examination.

The ureters are catheterized in the usual manner, a no. 6 French ureteral catheter is preferable, and it should also be non-opaque. The catheter is inserted almost to the kidney pelvis. In some cases this may not be possible. Then with the patient on the x-ray table, the hypodermic needle with the syringe barrel attached, is inserted into the free end of the catheter, and the rubber tubing is connected to the hypodermic barrel and the tank of oxygen. The oxygen is then passed slowly into the catheter at a constant rate of flow. In the cases observed so far, there occurs a primary rise of pressure in the pelvis as recorded by the manometer, which gradually increases to a point, usually between 30 and 45 mm. of mercury, when there occurs a fall in the pressure of about 15 or 20 mm. of mercury. If the flow of the oxygen has been kept constant there will continue to be a rise and fall of the pressure, between these two points. The fall of the pressure indicates that the degree of dilatation of the pelvis and calices is not constant and that the oxygen is returned alongside the catheter to the bladder, almost as fast as it reaches the pelvis. In the meantime the patient is encouraged to void whenever the bladder feels full, and the oxygen is passed out through the urethra, as an ordinary act of urination. A Rentgenogram obtained at this stage shows the presence of gas in a poorly outlined pelvis. The flow of oxygen is then gradually increased until the patient complains of a fullness in the kidney region. The pressure at this time varies, having been as high as 150 mm. of mercury in one case. The pressure is then allowed to increase about 20 mm. above the point at which the patient complained of discomfort and a Rentgenogram is obtained.

A résumé of the following case illustrates the advantage of pneumopyelography:

Mr. D. L., age twenty-seven, was admitted to the Hahnemann Hospital on the service of Dr. W. H. Bishop, November 26, 1921. His chief complaint was pain in the left side of his abdomen radiating downward toward his left thigh. Family history negative. Present illness began three years previous with a sudden sharp colicky pain in the left side of his abdomen radiating down along the course of the left ureter. This attack lasted for about six hours. Following this there was no polyuria,

hematuria or dysuria. During the past three years he has had a number of similar attacks of pain coming on from ten days to four weeks apart. In the last few attacks he had noticed a polyuria coming on im-



FIG. 2. THE PELVIS AND URETER FILLED WITH THE SODIUM BROMIDE SOLUTION

mediately after the pain stopped. He had also noticed some cloudiness of his urine at these times.

*Physical examination.* Practically negative with exception of a very much enlarged kidney on his left side, which was slightly tender on deep

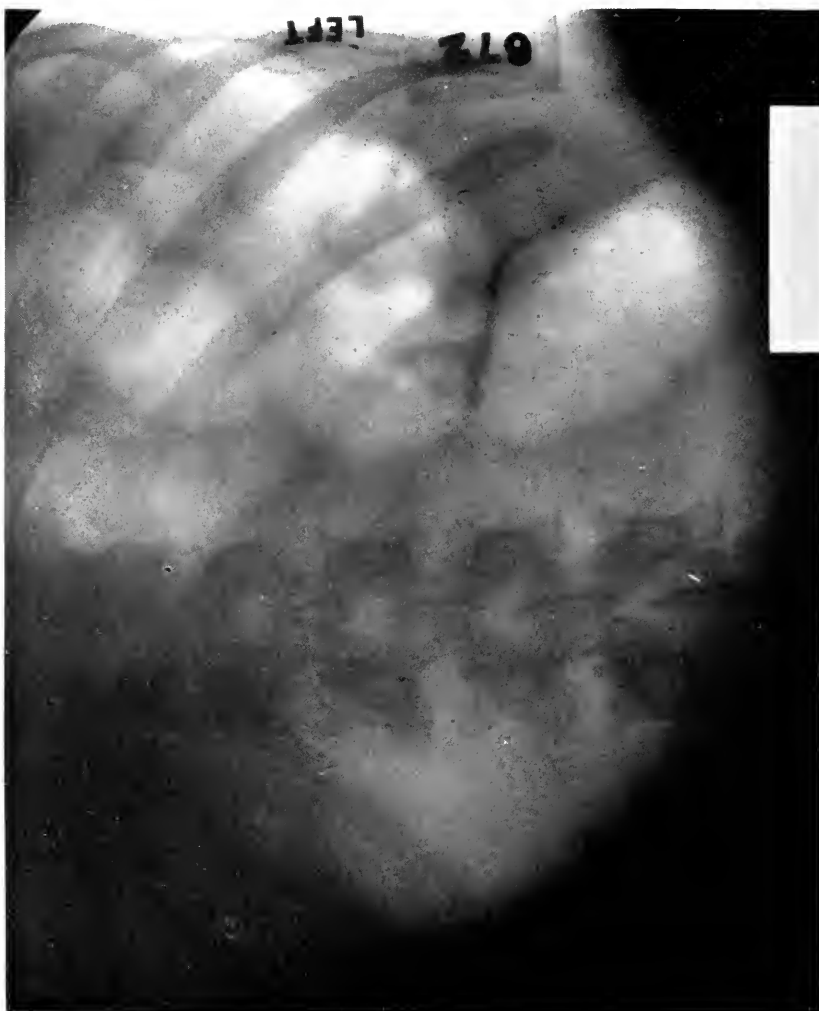


FIG. 3. THE SAME PELVIS AND URETER FILLED WITH OXYGEN, SHOWING A STONE WHICH HAD BEEN OBSERVED BY THE BROMIDE SOLUTION

palpation. Urinalysis on admission showed clumps of pus cells, otherwise negative. Wassermann reaction, negative. Blood urea, uric acid and creatinin were within normal limits. Phenolsulphonephthalin elimination from the right side was 69 per cent in two hours, from the left side, nothing in two hours.

On November 28, a cyptoscopic examination revealed a mild cystitis. The right ureteral orifice was large, round and of the golf hole type. The urine from this side was clear and light straw colored. The left ureteral orifice was slightly thickened and surrounded by an inflamma-



FIG. 4. THE SAME KIDNEY ON ITS REMOVAL FROM THE BODY

tory zone. The urine from this side resembled milky water. There was no obstruction of either ureter. The left renal pelvis was filled with oxygen and when the pressure reached 160 mm. of mercury a Rentgenogram was taken. The plate showed a very large kidney shell filled with gas, and at the beginning of the ureter, was a shadow 4 by 3 cm., which was thought to be a stone. The diagnosis was hydronephrosis and renal calculus. This plate had been so placed that the upper pole of the kidney was not shown. The patient experienced only slight discomfort during the procedure and had no reaction whatever following the oxygen injection.

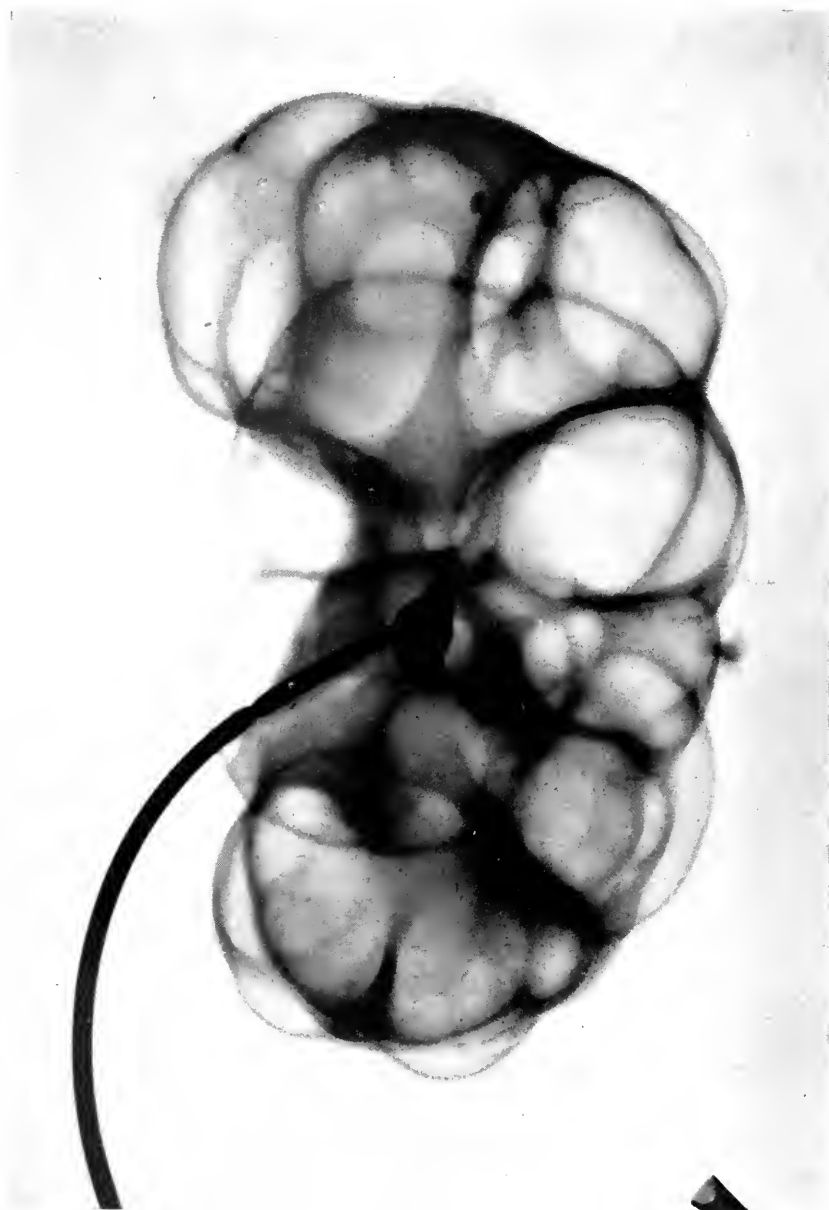


FIG. 5. A RENTGENOGRAM OF THE SAME KIDNEY FILLED WITH OXYGEN AFTER ITS REMOVAL



On November 29, the left ureter was again catheterized, the renal pelvis filled, with 20 per cent solution of sodium bromide (fig. 2) and a pyelogram made. Six ounces of the bromide solution was injected before causing the patient any discomfort. This plate showed very large kidney shell filled with the opaque solution. The shadow observed in the first pyelogram was not seen. About half an hour afterwards the patient experienced a dull aching pain in the left kidney region which lasted for about twelve hours.

On December 2, the left ureter was catheterized and the renal pelvis filled with oxygen, the amount of pressure used was 180 mm. of mercury (fig. 3) and a pyelogram obtained. This plate showed the same as the previous oxygen pyelogram with the exception that the whole kidney was seen. There was no discomfort during the procedure and no reaction following.

At operation, December 5, the left kidney was found to be enormously enlarged, constituting practically nothing but a large shell filled with a milky fluid. The kidney was removed (fig. 4) and taken immediately to the X-ray room where it was filled with oxygen and a Rentgenogram made (fig. 5). On section the kidney contained a large stone about 4 by 3 cm. tightly adherent to the pelvis and partially obstructing the ureter.

#### CONCLUSIONS

1. Pneumopyelography is a simple, though uncommon, procedure and deserves a greater popularity.
2. Its procedure is attended by apparently no reaction and causes the patient less discomfort than the injection of an opaque solution.
3. In certain cases it is a greater aid in Rentgenographic diagnosis, than the opaque solutions.



## DISSOLUTION OF CALCULI IN THE RENAL PELVIS AND URETER<sup>1</sup>

ROBERT C. BRYAN AND R. D. CALDWELL

Prompted by an article "The Solubility of Phosphatic Kidney Stones" by Dr. J. F. Geisinger, appearing in the Journal of the American Pharmaceutical Association, April, 1918, the writer's attention was directed further to the feasibility of attempting the dissolution of renal and ureteral stones by the application of acids or other media designed to dissolve the stones.

### GENERAL CONSIDERATION OF STONES

The recapitulation of the chemistry of stones shows the following:

*Uric acid and urates* form nuclei of about 81 per cent of urinary concretions, they are usually colored and smooth.

Uric acid crystals are soluble in 1:1500 parts of water at 20°C. They are also soluble by being oxidized in hot concentrated nitric acid. They are likewise soluble in alkalis, as sodium hydroxide stronger than 5 per cent, which solution is much too strong for tissue. These stones are not soluble in alcohol and ether, however.

The normal heat of the body and urinary pigments aid in keeping uric acid in solution.

Ordinary acid throws uric acid out of solution. These stones are soluble in potassium carbonate very slowly and should be boiled. Also soluble in lithium carbonate.

Urates are salts of uric acid. Urate calculi are rarely found in adults but may be found in infants. They are generally soft and highly pigmented.

Lithium carbonate acts on uric acid producing lithium urate, which is more soluble than other urates. Tried on pure powder of uric acid with no result at body temperature.

<sup>1</sup>Read at the meeting of the American Association of Genito-Urinary Surgeons, May 2 and 3, 1921, Richmond, Va.

These calculi are soluble in concentrated hot acid solution. Both the above are found usually in acid urine, but may have phosphatic deposits around them in alkaline urine.

*Calcium oxalate* forms the nucleus of about 6 per cent of all stones.

Calcium oxalate calculi are next in frequency to uric acid calculi. These are the hardest stones and are usually very rough.

These stones are oxidized by warm permanganate in an acid solution, preferably in sulphuric acid solution, which the tissues could not stand. If in HCl, free chlorine, carbon monoxide and carbon dioxide would be given off. They are likewise soluble in dilute HCl.

*Phosphates of calcium magnesium and ammonium* are found soluble in any weak acid solution, best in hydrochloric acid yielding phosphoric acid and calcium magnesium and ammonium chloride.

*Phosphates of alkaline earths* form a nucleus for about 9 per cent of all stones.

*Calcium carbonate calculi* are rarely found in man but frequently in herbivora. They are soluble in any dilute acid with gas carbon dioxide given off.

Nearly all stones are mixtures of urates, uric acid, phosphates, etc., plus some organic framework. Finstires found but 6 pure stones in a series of 114 examined, but he did not state of what substance they were.

All stones have a framework of organic matter as fibrin, mucus and white blood cells which is left after the hard substance is dissolved out. This framework or skeleton remains after the dissolution, having practically the same size and shape as the original stones, but is soft and can be readily mashed between the fingers.

From the table of composition of stones given above we find that only about 13 per cent of stones are of such a composition as to allow an attempt of their dissolution while in the pelvis of the kidney. These, carbonates and phosphates, chiefly, are rarely pure but contain usually a nucleus of urates or uric acid

and are always intimately mixed and coated over with mucin, fibrin, bacteria and white blood cells which prevent the solvent from coming in contact with the inorganic material of the stones.

An interesting feature about the dissolution of stones by the constant application of acid, as has been shown by Dr. Geisinger's monograph, is that the stones contain some organic matter, which, while saturated with the solution, remained as large as the original stone and of the same color but of such a consistency that they could hardly be handled without breaking, and could easily be moulded into any shape. On drying this residue would contract to about one-tenth of its original size and become dark brown to black in color.

After a series of experiments by Dr. Geisinger, 2 per cent aluminium acetate, 5 per cent ammonium chloride and 1 per cent hydrochloric acid were used in the dissolution of the stones; the effect of these acids upon the stones is shown in the following table:

STONE	WEIGHT	SOLUTION USED	NUMBER OF DROPS	NUMBER OF CUBIC CENTI-METERS USED	NUMBER OF CUBIC CENTI-METERS USED PER MILLIGRAM	WEIGHT OF RESIDUE
	<i>grams</i>					
A	0.1778	2 per cent aluminium acetate	25	500	2.81	0.1694
B	0.3352	5 per cent ammonium chloride	27	2000	5.98	0.3302
C	0.1316	1 per cent hydrochloric acid	19	2500	19	0.011
D	0.1694	1 per cent hydrochloric acid	20	720	4.25	0.0132
E	0.1818	1 per cent hydrochloric acid	15	80	0.44	0.0118

Having ascertained that HCl was the most desirable of all media for the dissolution of stones many interesting phenomena developed as our studies progressed, among others the strength of the solutions to be used and their effect upon the normal mucosa of the ureter and pelvis of the kidney.

Catheterization of the ureters in the male dog is an impossibility and on several occasions the writer has attempted to catheterize the ureters of the female dog with more or less success.

To further our studies then, dogs were anesthetized and the ureter segregated and submitted to the action of acids, which showed the following:

*First dog.* Female dog, weight 14 pounds, 636 kgm., 25 cc. H<sub>2</sub>O by mouth per kilogram of body weight; 1 cc. phenolsulphonephthalein injected in buttock muscles. Thalein appeared in urine in ten minutes. Twenty-four per cent phthalein output in first hour, could not obtain specimen second hour. Three days later dog anesthetized with ether, 5 cc. 10 per cent HCl injected through ureter into pelvis of left kidney. The dog was dead in two minutes after injection. Dog's blood was faintly acid to litmus after death. Five minutes after injection of acid the kidney was removed and washed, splitting the kidney in half longitudinally. Microscopic examination of ureter and pelvis of kidney showed slight coagulative necrosis of mucous membrane lining the pelvis of the kidney. When the kidney was cut open longitudinally cortex and medulla showed brown streaks from action of HCl on blood. The pelvis was white and brittle.

*Second dog.* Dog anesthetized and 5 cc. of 5 per cent HCl injected into pelvis of kidney as in other case. There was no change in pulse or respiration. Fifteen minutes later the kidney was removed and washed. The organ was streaked with brown very much the same as in the case of 10 per cent acid but not as much. Microscopic examination of the pelvis showed no change in cells.

*Third dog.* Dog anesthetized and 1 per cent HCl (3 cc.) injected into pelvis of kidney as before, twenty minutes later the kidney was removed and washed. The macroscopic appearance was normal and no change could be noted on microscopic examination of the pelvis.

Remarks: In all these cases the kidney substance was diseased due to long standing nephritis in the dogs and not to the acid injection. No microscopic change in the kidney other than congestion because the dogs were killed before the tissue had time to react.

The following series would indicate that there is a distinct pathologic response to 5 per cent solutions of HCl.

*Dog 1.* Five per cent HCl injected into the right ureter through abdominal incision of small dog. Six days later the dog was killed with chloroform and severance of carotid artery, and the following noticed: Right kidney large and pale. Pelvis and ureter soft, yellow

and easily broken. The kidney was opened through midline incision and it was filled with pus and entire, or nearly all of medulla had sloughed away. The kidney had enormous blood supply. Microscopic section showed left kidney normal. Right kidney filled with pus, congested and all of mucous membrane, pelvis and part of medulla gone or chiefly a mass of pus cells. Section of ureter on right side showed wall and lining mucous membrane replaced by a mass of pus cells.

*Dog 2.* Five per cent HCl injected into right ureter in the same way. After twenty-four hours the dog was killed with chloroform and severing carotid artery. Mucous membrane of both the right ureter and pelvis showed complete destruction and surrounding tissue congested and heavily infiltrated with polymorphous nuclear leucocytes.

*Dog 3 (primo).* Small poorly nourished dog. In the usual way the dog was anesthetized and 1 per cent HCl injected into right kidney through ureter. The dog died at the end of two days. Right kidney slightly larger and presented a pale appearance. Microscopically the kidney was congested and the mucous membrane was destroyed from the pelvis of the kidney and infundibulum of the ureter.

*Dog 4 (primo).* One-half of 1 per cent HCl injected in usual way. Dog died in a few hours, sometime the following night. Was sick and poorly nourished which accounts for death. General appearance of the kidney normal. Microscopically the kidney pelvis showed slight vascularity and round cell infiltration under the mucosa, mild sloughing of mucous membrane in spots with cloudy swelling of marginal cells of mucosa. Ureter showed same changes.

*Dog 5 (primo).* One-half of 1 per cent HCl injected and dog killed in seven days. Kidney normal size, pale, appearance congested and round cell infiltration beneath the mucosa with hyperplasia of mucous membrane showing there had been some destruction followed by repair. Ureter showed same changes. At the end of six days the dog showed 100 per cent phthalein output.

*Dog 6 (primo).* One-fourth of 1 per cent HCl injected as usual. Kidney normal in size and appearance. Mucous membrane normal, slight increased vascularity and round cell infiltration in tissue beneath mucosa. Ureter normal. This dog was killed at the end of six days.

MacNider, Chapel Hill, North Carolina, states that most dogs have Bright's disease, probably due to mange and skin infections producing a glomerular nephritis. Urine may be normal, free from albumin, of a normal specific gravity, but there

is a decrease phthalein output averaging around 45 per cent. This glomerular nephritis is evident by microscopical section in all cases. It would seem, therefore, that the moth ball test of the dog for an accurate estimation of the kidney output is based upon false premises, although in one of our cases, dog 5, primo, showed 100 per cent phthalein output.

At first our intention was to do a nephrotomy placing a human stone in the pelvis of the dog's kidney and in other instances smaller ones in the ureter. This latter proposition, however, did not appeal to us as it would have produced blocking of the ureter and establishment of a nephrostomy wound, with the added possibilities of infection. Placing a stone in the pelvis of the kidney would give rise to an unnatural state which would not obtain in the normal and this plan was abandoned.

Dr. Geisinger recently reports a case in which a stone was brought from apparently the uretero-pelvic junction to the brim of the pelvis by irrigations of the ureter and pelvis of the kidney with hydrochloric acid, dissolving sufficient crystals to allow the framework above mentioned to adapt itself to the shape of the ureter and by the vermicular action of the same to be projected downwards, and I believe at present he is engaged in a series of investigations which will be reported later.

The case which we herewith report, in whom the stone was removed by operation following repeated attempts at dissolution with 0.8 per cent U. S. P. hydrochloric acid was placed in the patient's urine, made 0.5 per cent acid with hydrochloric acid. At the end of 36 hours the stone could be crushed between the fingers to little granules like sand of the inorganic material surrounded by soft gelatinous material, which proved to be fibrin and blood.

Another portion of the calculus after being in patient's urine made 5 per cent acid with HCl for thirty-six hours remained the same size, but the inorganic material was a small speck in the center surrounded by gelatinous material.



## CONCLUSIONS

1. The means for determining the character of stones can be estimated only by the density of the shadow by X-ray, and by urinalysis, at which time we hope to catch crystals from the stone which may be most misleading.

2. The only stones amenable to dissolution are the phosphatic, which constitute only 9 per cent of all stones, and the calcium carbonate (very rare), which constitute 4 per cent of all stones.

3. Stone formation is always attended with the presence of pus. This condition is aggravated by topical applications.

4. Many stones may be assisted in their expulsion by ureteral dilatation and lubrication.

5. Operation, in the upper tract, pyelotomy, in the lower tract, by intramuscular gridiron incision, is attended with such happy results that experimentation with solvents would seem impracticable.

6. The mucosa of the dog lining the pelvis and the ureter can stand 0.5 per cent hydrochloric acid U. S. P., stronger than this shows a round cell infiltration and destruction which in course of time is not followed by repair.

J. M., 2826 Mile Road, City. Age thirty-seven, F., single, American. Occupation housework.

Admitted to the Virginia Hospital, September 6, 1920 probable diagnosis renal lithiasis. On admission temperature 99.4°, pulse 88, respiration 22.

*History*

*C. C.* Pain in left side of back, lower part. Began about a year ago, and has been getting worse up to present time. Pain not constantly present but is brought on when patient is walking or resting on her back, when lying on side in bed pain does not give nearly as much trouble. Voiding caused pain to become worse for a short while. Pain comes on in attacks, some severe enough to cause patient to go to bed.

*Head.* Patient suffers with headache constantly, worse at night. Dizzy at times, feels as if she is going to fall.

*C. R.* Edema of ankles upon standing, shortness of breath upon slight exertion. No cough, expectoration, hemoptysis or night sweats.

*G. I.* Appetite not good. No indigestion, abdominal pain or history of jaundice. Habitually constipated, nauseated after eating, especially meats, no vomiting. Hemorrhoidectomy ten years ago.

*G. U.* Nocturia, one or two voidings, but patient has had very frequent night voidings, about two weeks ago pain upon micturation followed by burning, no retention or difficulty in voiding, but a tendency to incontinence at times.

*M. H.* Began at fifteen, lasts four to five days, regular up until ten years ago at which time patient underwent abdominal operation on pelvic organs, has not menstruated since, no vaginal discharge at present time. No history of gonorrhoea or syphilis, one child born and miscarriage two years after marriage. Married at 17.

*Habits.* One cup of coffee per day. No insomnia, loss of weight in past year.

*F. H.* Father living, mother dead, 2 brothers living, 2 sisters living. History of cancer, syphilis, T. B. and insanity negative.

*P. I.* Patient has had usual childhood diseases. Typhoid last year. Appendicitis and operation fifteen years ago, operation on pelvic organs ten years ago. Operation for gall stones last year and abscess of abdomen one month after gall bladder operation in incision of same operation.

*Physical examination.* Negative except for scar of previous operation and a marked tenderness over left kidney region in back. Pressure there causes a sick sensation.

*Urinalysis, September, 7, 1920.* Yellow, cloudy, 1020, acid, very slight trace of albumin, sugar negative, acetone negative, diacetic acid negative, indican negative, very few pus cells and mucus.

*September 7, 1920, X-ray for calculus.* Patient has small stone approximately  $\frac{1}{8}$  by  $\frac{1}{8}$  inches in the pelvis of the left kidney. The kidney is normal in shape, size and position.

*September 15, 1920, cystoscopic examination.* Bladder mucosa, trigone and ureteral ora normal. Both ureters catheterized, no obstruction. Specimens collected. Dye test appearance from both kidneys 5 minutes.

*September 15, 1920.* Right kidney 20 cc. 10 per cent, microscopic abundant blood, few pus cells.

*September 15, 1920.* Left kidney 20 cc. 20 per cent, microscopic abundant blood, few pus cells; 40 cc., 30 per cent total. Bladder 5 per cent.

*October 7, 1920, X-ray of left kidney.* The small calculus referred to

in previous report is still present in pelvis of left kidney. In addition to this there is a very faint shadow about the same size, or probably a little larger which is probably a second calculus. The latter is situated  $\frac{1}{2}$  inch above the former.

*October 8, 1920, urinalysis.* Few amorphous urates, very few pus cells, some mucus.

*October 11, 1920, cystoscopic examination.* Urethra, bladder mucosa and left ureteral os are normal. The left ureter is readily catheterized, catheter reaching the pelvis with no difficulty; 4 cc. of urine is aspirated from the left pelvis and 5 cc. of a 0.6 per cent solution of hydrochloric acid is then injected into the pelvis of the left kidney with the patient inverted. There is no evidence of pain or discomfort. This is held for three or four minutes, the pelvis again aspirated, 3 cc. being obtained and 5 cc. of 6.1 per cent solution of hydrochloric acid again injected into the kidney. Some bubbles come away which are caught through water and this is subjected to examination and proved to be only air. The patient complained of no pain at any time during the operation. There are no evidences of trauma.

*October 12, 1920, urinalysis.* Yellow, cloudy, 1020, acid, trace albumin, sugar negative, acetone negative, diacetic acid negative, indican negative, frequent blood, abundant bacteria.

*October 13, 1920, blood examination.* White cells 9,201, polys 75, small lymphocytes 25.

*October 16, 1920, X-ray of left kidney.* Calculi are still present. As there was some movement of the kidney during exposure it is impossible to state the size of the calculi as compared to previous plates.

*October 18, 1920.* Left ureter catheterized, 5.5 cc. of normal appearing urine aspirated. Kidney is injected with 6 cc. of 0.6 per cent solution of hydrochloric acid, table inverted and fluid kept in contact with stone about ten minutes. No ebullition of gas is noted.

*October 20, 1920, urinalysis.* Yellow, cloudy, 1012, acid, albumin light trace, sugar negative, acetone light trace, diacetic acid negative, indican negative, good deal of sediment, good many triple phosphates, few pus cells.

*October 22, 1920, urinalysis.* Light amber, clear, acid, 1010, very faint trace of albumin, sugar negative, debris, bacteria, etc., found in twenty-four hour specimen, moderate number of pus cells, occasional red blood cell, no epithelium or crystals (twenty-four hour specimens second day after injection of 0.6 per cent HCl into pelvis of kidney).

*October 23, 1920.* Patient went home, no X-ray being taken because of the fear of X-ray burn, she having had several in the last two weeks.

*November 14, 1920.* Has pain in left side, particularly at night, urine burns, no medicine, drinks large quantities of water, appetite fair, bowels good, pain runs to neck of bladder.

*November 20, 1920.* A concretion approximately 3 mm. by 2 mm. is seen in the region where the pelvis of the kidney was seen to be on previous X-ray examination.

*January 15, 1921.* Returns to hospital. Has had considerable pain and distress in costo-vertebral angle and along course of ureter.

*January 20, 1921.* X-ray shows two small stones in the same location as the former shadows.

*January 21, 1921.* The left ureter is readily catheterized, the catheter mounting to the pelvis of the kidney with apparently no embarrassment, pain or trauma. Aspiration of the pelvis is attempted but nothing returns. The patient is gently inverted and 9 cc. of an 0.8 per cent solution of U. S. P. HCl is injected slowly into the pelvis of the left kidney until there is evident tension. This solution is left in contact with the lining of the pelvis for three minutes, then allowed to return and the pelvis is irrigated with sterile water. There is marked spasm of the ureter on attempted withdrawal of the catheter so much so that it is started with considerable difficulty. The specimen herewith is the returning HCl through the catheter from the kidney.

*January 22, 1921, urinalysis.* Yellow, cloudy, 1012, acid, albumin heavy, sugar negative, acetone negative, diacetic acid negative, abundant blood cells.

*January 26, 1921.* Wassermann negative.

*February 2, 1921, blood count.* 8,400, 76 polys, 22 small, 2 eosin.

*February 2, 1921, urinalysis.* Yellow, clear, 1012, acid, no albumin, very few pus cells and blood cells, little sediment.

*February 14, 1921, operation.* General anesthetic ether, left kidney incision. The kidney is readily reached, delivered, stripped of fat, is apparently normal in shape, color and outline. A long straight needle is thrust through the convex border just below its center and a distinct click is noted. The kidney is held firmly in the left hand and an incision made along the convex border to the pelvis. The finger in the pelvis feels no stone, but continuing the incision a very small stone is found embedded in the substance of the kidney in one of the lower papilla, surrounded by fibrous tissue. The fibrous tissue is scraped away and the stone readily removed. The kidney is brought together with mattress sutures, four in number, superimposed continuous catgut no. 2 through capsule. A small wick of rubber is placed in the kidney bed

and brought out at the lower angle of the wound. Tissues approximated with catgut no. 2, silkworm gut through skin.

*February 22, 1921.* Stitches removed.

*February 28, 1921.* Patient up in chair and about.

The writer wishes to express his thanks to Dr. Jos. F. Geisinger, whose advice, suggestions and collaboration have at all times been most appreciated and who has offered his monographs and tables which have been freely used in this article.

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## SURGICAL INFECTIONS OF THE KIDNEY<sup>1</sup>

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Embryologically, the kidney has a double origin; from the Wolffian duct spring the ureter, pelvis, calices and straight collecting tubules, all lined with pavement epithelium and furnishing the mechanical or collecting part of the kidney.

From the mesothelium springs the secreting or filtering portion of the kidney—the arterial or cortical side of the organ. It is within the mesothelial or secreting portion of the kidney that the majority of the non-surgical lesions of such absorbing interest to the internist take place, such as the various types of nephritis, both acute and chronic. Such conditions, most likely, are of toxic, non-bacterial origin, affecting both kidneys simultaneously and equally.

The cortex or filtering portion may likewise be the prey of a blood-borne infection from pyogenic organisms, thereby producing an hemotogenous nephritis, the degree and extent of which will depend on the type and strain of the invading germs. Here we are dealing with a frank infection, in which one kidney alone may be involved, as is frequently the case; or if both, one will be more markedly affected than the other, by reason of some mechanical or crippling disability.

A kidney into whose substance pyogenic organisms have once found lodgment must always be considered a real danger until all trace of infection has been removed.

The most dramatic of all renal infection is that presented by the acute fulminating type of either staphylococcic or streptococcic origin, the so-called "septic infarct kidney." To Brewer, of New York, belongs priority and credit for much excellent clinical and experimental work done on this, the most serious and fatal

<sup>1</sup>Read before Joint Session of American College of Surgeons of Alabama, Georgia and Florida, in Atlanta, Ga., January, 1921.

of all kidney infections. In its explosiveness, in the rapidity with which profound constitutional disturbance supervenes, there is nothing comparable to it unless it be a malignant pancreatic infection or a perforation of a gastric or duodenal ulcer. The vagueness and oftentimes total absence of localizing renal symptoms, render the condition exceedingly difficult to differentiate from other intra-abdominal lesions. In Brewer's thirteen reported cases, abdominal incision was first made in three; Farrar Cobb reports eight cases, in three of which abdominal incision was first employed. Fortunately, this condition is more often than not unilateral; and if its possible presence is constantly borne in mind, when confronted by serious intra-abdominal disturbance, one can usually elicit definite costo-vertebral tenderness on the affected side—most often the right side, and usually in a multiparous female, because the majority of all kidney infections occur in the female and on the right side.

The chief obstacles in these desperately malignant types of renal infection are:

1. To differentiate it from similar explosions which may occur either in the appendix, gall bladder, stomach or pancreas.

2. To distinguish it from the more acute pyelitis or pyelonephritis which may also have a very stormy beginning.

3. Even though the diagnosis of septic infarcts of the kidney be correct, to decide whether or not such an acutely ill patient can tolerate the amount of surgery necessary to correct the existing pathology.

Once suspicion is directed to one kidney, it is of superlative importance, if the exigencies of the case will permit, to determine the working capacity of its fellow; because the damage done in these infections is such as to nearly always necessitate removal.

Nephrectomy, then, is the appropriate treatment; any measure short of this in the malignant type, usually spells disaster; if the condition be recognized sufficiently early and if the opposite kidney's functional capacity be good, the patient's life will be saved.

In twenty-six cases reported by Brewer, Cobb, Cotton and Rinckenberger, fifteen were treated by nephrectomy with only one death; ten were treated by nephrectomy and drainage with five deaths.



Such, in very brief outline, is the most tragic picture in all kidney infections.

Should the invading organisms be of a less virulent strain, as they most often are, we then have a patient who, while acutely ill, is not desperately so. The localizing symptoms of loin pain and tenderness, together with vesical irritability and urinary frequency are definitely present to guide us aright and the urinary findings of pus, or pus and blood, are seldom wanting.

The final outcome of such an infection as this may be:

1. Complete recovery, with no demonstrable trace of damage done the kidney substance.

2. The formation of one or more cortical abscesses which may:

- a. Either break through the kidney capsule, terminating in a perinephritic abscess, or;

- b. Find an exit from the cortex through the calices of the kidney and into the pelvis, thus giving rise to a urine more or less loaded with pus, the amount depending upon the size of the abscess and the freeness of the drainage. This latter condition gives rise to the pyonephrotic kidney, which, as is well known, may smoulder for years without giving rise to markedly disabling symptoms other than a persistently purulent urine. The treatment of this type of kidney is nephrectomy, provided the functional capacity of its companion is good. Nephrotomy will sometimes suffice; but usually the condition is of such long standing and the destruction of tissue so great, that conservation is not justifiable.

The lesions briefly considered above have their origin primarily in the cortex or arterial side of the kidney. Cabot and Crabtree have shown that the pus cocci attack the cortex, while the colon bacillus prefers as his field of activity the straight collecting tubules and the pelvis—in other words, the collecting part of the kidney or that portion derived from the Wolffian duct. These findings harmonize with Rosenau's views as to the elective localization of bacteria and serve to explain why, in pyelitis, even though of long standing, no appreciable damage may accrue to the secreting portion of the kidney nor abscess formation result.

Lesions of the collecting portion of the kidney, which includes the pelvis and ureter, constitute by far the major portion of the infections found in the upper urinary tract. As to the fre-

quency of pyelitis, all medical men, physicians and surgeons alike, can amply testify. As to the frequency of ureteral lesions, resulting oftentimes in strictured areas of this duct, there is some divergence of opinion, due largely, in the writer's opinion, to a failure to employ the proper methods of detecting such obstruction.

After a careful study of the subject and the close observance of more than seventy-five cases of pyelitis and ureteral stricture, the writer is firmly convinced not only of their frequent occurrence, but also, by reason of the close mimicry of other lesions, of the fruitlessness of many abdominal operations undertaken for their relief. In an analytical study recently made of fifty cases of pyelitis and ureteral stricture, it was found that seven or 14 per cent had been operated, during an acute exacerbation, for acute appendicitis. Two of these seven were mistakes committed by the writer himself, in which the pathology present in the appendix and remainder of the peritoneal cavity in no way accounted for the acuteness of the clinical symptoms and in which, later post-operative studies revealed the true condition to be in the ureter and kidney pelvis. The similarity of the symptoms presented by an acute pyelitis or stricture to those of an acute appendix are indeed quite striking. Yet by carefully considering, always, the possibility or probability of the retro-peritoneal lesion, and by insisting upon such a study of the upper urinary tract as the urgency of the case will justify, the operator will, sooner or later, spare himself both chagrin and embarrassment.

Again, in the study above referred to, eleven, or 22 per cent had been operated for "chronic appendicitis" alone, exclusive of the 14 per cent operated for an acute condition. In six, or 12 per cent the diagnosis of "chronic appendicitis" had been made and operation advised. In nine, or 18 per cent the primary surgical assault had been made on the reproductive organs alone. All told, twenty-seven, or 54 per cent had either been operated upon or had had operation advised as the necessary remedial measure.

In conclusion, therefore, permit me to leave this parting word of caution with you

Pay careful heed to the upper urinary tract before making your abdominal incision.

## THE TOXICITY OF POTASSIUM CHLORIDE IN EXPERIMENTAL NEPHRITIS

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It is a common practice in the therapy of nephritis to administer certain potassium salts for their diuretic influence. On the other hand, it is well recognized that in general potassium salts are much more toxic under normal conditions, than the corresponding sodium salts. It is, therefore, quite logical to assume that, in such a disease as nephritis, the same fact should obtain, and further, that, since the rate of elimination of the salt may be considerably diminished in nephritis, potassium salts may possess an even greater toxicity than under normal circumstances.

The significance of the possible detrimental effects of potassium salts in nephritis has been shown by Smillie (1). This investigator has demonstrated that certain cases of chronic nephritis fail to excrete even sodium chloride in a normal manner. Thus, in several instances, the inclusion of 10 grams of sodium chloride in the dietary, resulted in either a failure or a diminution of excretion. When it was definitely demonstrated that a certain case was unable to eliminate normally 10 grams of sodium chloride, the patient was given potassium chloride in a single dose of 5 to 10 grams in 150 c.c. of water. In some instances this procedure resulted in an increased chloride excretion. In other cases no apparent effect could be noted. In one instance, the administration of 10 grams of potassium chloride induced weakness, abdominal distress, vomiting and precordial pain. There was marked cyanosis and a weak, irregular pulse. From the results obtained in this case, Smillie was led to investigate the matter further by animal experimentation.

<sup>1</sup>The data are taken from the thesis of Roy C. Ferguson presented in partial fulfillment of the requirements for the degree of M.D., Yale University, 1920.

The method of procedure adopted by Smillie was as follows: The toxicity of potassium chloride was determined in normal rabbits. This having been established, the maximal sublethal dose of potassium chloride was administered per os. A moderate nephritis was then induced by means of uranium nitrate. Under these conditions the non-protein nitrogen of the blood gradually increases, and affords a measure of the extent of renal damage. When the non-protein nitrogen of the blood had reached a sufficiently high level, a relatively small dose of potassium chloride was given. The animal usually succumbed in a short period of time. Autopsy revealed the typical lesions of uranium nephritis. In all ten experiments were carried through. A typical experiment may be cited. A rabbit received by way of the mouth 3 grams of potassium chloride, dissolved in 50 cc. of water, resulting in a rapid elimination of the salt. Uranium nephritis was then induced. When the non-protein nitrogen of the blood reached 118 mgm. per 100 cc. of blood, one gram of potassium chloride was given in 50 cc. of water. The animal died in 15 minutes. From these experiments the conclusion is drawn by Smillie that potassium salts are distinctly more toxic in certain types of nephritis than under normal conditions.

It has been shown by various investigators (1) that death does not occur in uranium nephritis until the non-protein nitrogen of the blood has reached a level of from 150 to 250 mgm. per 100 cc. of blood. Moreover, animals in this condition give definite symptoms when death is impending. In his experiments, Smillie attempted to produce moderate nephritis and then to administer potassium chloride before severe symptoms incident to the injury developed. In every instance it was found that 1 gram of potassium chloride caused immediate death in the nephritic rabbits whereas 3 grams were without influence upon normal animals.

According to Smillie death was caused by the concentration of potassium chloride in the blood, the diseased kidneys being unable to eliminate it with sufficient rapidity to prevent its toxic action upon the heart muscle.

## EXPERIMENTAL

*The toxicity of potassium chloride in tartrate nephritis*

In the present investigation the problem of the toxicity of potassium chloride in experimental nephritis has been attacked from a slightly different viewpoint. In the first place it seemed desirable to introduce the salt by some path other than the alimentary canal inasmuch as it is well known that in the rabbit the gastro-enteric tract is usually so filled with material that the possibility exists for a very diverse rate of absorption into the blood stream of any specific substance taken by the mouth. For the purpose of obtaining more accurate measurements of toxicity, potassium chloride has been injected at a determined rate directly into the blood stream. Again, different experimental nephritides may show a variable excretion power with respect to the elimination of introduced salt. Thus in the condition induced by uranium nitrate pronounced effects are produced upon both the glomerular mechanism and upon the convoluted tubules, a fact which would predicate the probability that salt excretion would be appreciably diminished. On the other hand it has been shown by Underhill, Wells and Goldschmidt (2) that tartaric acid causes a nephritis in which the specific influence is exerted upon the convoluted tubules, the glomerular mechanism for the most part escaping serious injury. In accord with this is the observation (3) that in tartrate nephritis sodium chloride is eliminated in an apparently normal manner whereas introduced urea fails to reappear to an appreciable extent. It must therefore be quite evident that the toxicity of potassium chloride in nephritis will depend directly, in the first place, upon the portion of renal tissue damaged and secondly upon the extent of the damage to this mechanism.

*Methods:* Full grown rabbits were employed as experimental animals. Nephritis was induced by the subcutaneous injection of 1.0 gram of tartaric acid, per kilogram of body weight, neutralized with sodium hydroxide. Inasmuch as, with tartrate nephritis, the animal refuses food, the experiments were carried through with the rabbits in a fasting condition. As a measure

of the extent of injury to the renal mechanism urinary analysis involving the estimation of total nitrogen and total chlorides was made upon twenty-four hour samples of urine, obtained by compression of the bladder through the abdominal wall. Previous to the administration of the tartrate, urinary analyses were obtained for a period of two days as criteria for the normal rate of elimination of the substances mentioned above. Total nitrogen was estimated by the Kjeldahl method, chlorides according to the Volhard procedure. When evidence was obtained for significant renal damage, usually on the day following the administration of the tartrate, approximately isotonic potassium chloride was introduced, without anesthesia, from a burette into the marginal ear vein at the rate of 4 cc. per minute. The protocols of the individual experiments follow.

From the results outlined in table 1 it is quite evident, that, in tartrate nephritis, total nitrogen excretion is appreciably diminished whereas that of the chlorides in general shows no such action, data which tend to confirm the observations of Underhill, Wells and Goldschmidt already cited. It is also quite apparent that the toxicity of potassium chloride when injected into the blood stream in animals suffering with tartrate nephritis is quite variable, death being produced with doses ranging from 0.23 gram to 0.43 gram per kilogram of body weight. It is possible that this variable toxicity is explicable upon the basis of the extent of injury to the renal apparatus. From the criterion of nitrogen elimination, this appears quite plausible.

#### *The toxicity of sodium chloride in tartrate nephritis*

In order to demonstrate the relative toxicity of potassium and sodium chloride in tartrate nephritis, rabbits were maintained under the conditions cited above, except that sodium chloride was injected instead of potassium chloride. The results of two such experiments may be found in tables 1 and 2.

It is quite apparent from the data in table 2 that the intravenous injection of large quantities of sodium chloride is without appreciable detrimental influence upon rabbits with tartrate nephritis.

TABLE I  
*The toxicity of potassium chloride in tartrate nephritis*

DATE		URINE					REMARKS
		Volume	Specific gravity	Reaction to litmus	Total nitrogen	Chlorides as NaCl	
1919		cc.			grams	grams	
							Rabbit of 1.7 kilos body weight
October 28							No analysis
October 29	64	1.006	Acid	0.793	0.03		Water intake, 50 cc.
October 30	3		Acid	0.006	0.015		Injection of 1.7 grams tartaric acid subcutaneously
							Water intake, 45 cc.
							Injection of 45 cc. 0.9 per cent KCl in twelve minutes caused death = 0.23 gram KCl per kilo body weight
							Fasting rabbit of 1.6 kilos body weight
November 4	53	1.025	Acid			0.04	No water taken
November 5	28		Acid	0.800		0.04	No water taken
November 6	18		Acid	0.090		0.09	Injection of 1.6 grams tartaric acid subcutaneously
							No water taken
							Injection of 78 cc. 0.9 per cent KCl in twenty-one minutes caused death = 0.43 gram KCl per kilo body weight
							Fasting rabbit of 1.9 kilos body weight
November 11	69	1.023	Alkaline	0.710		0.24	No water taken
November 12	76	1.020	Acid	0.970		0.10	No water taken
November 13	25		Acid	0.110		0.15	Injection of 1.9 grams tartaric acid subcutaneously
							Water intake, 120 cc.
							Injection of 67 cc. 0.9 per cent KCl caused death in seventeen minutes = 0.31 gram per kilo body weight

TABLE 2

*The toxicity of sodium chloride in tartrate nephritis*

DATE	URINE					REMARKS
	Volume	Specific gravity	Reaction to litmus	Total nitrogen	Chlorides as NaCl	
1919	cc.			grams	grams	
						Fasting rabbit of 1.4 kilos body weight
December 2	71	1.018	Acid	0.79	0.24	No water taken
December 3	72	1.025	Acid	1.32	0.14	No water taken
December 4	7		Alkaline	0.06	0.04	Water intake, 130 cc.
						Injection of 1.4 grams tartaric acid subcutaneously
						Injection of 140 cc. 0.9 per cent NaCl in thirty-five minutes with no detrimental influence = 0.9 gram NaCl per kilo body weight
						No water taken
December 5	Few				0.03	
1920						Fasting rabbit of 1.8 kilos body weight
February 3	20		Acid	0.47	0.06	Water intake, 168 cc.
February 4	46		Acid	0.93	0.04	Water intake, 100 cc.
February 5	4		Acid	0.02	0.015	No water taken
						Injection of 1.8 grams tartaric acid subcutaneously
						Injection of 150 cc. of 0.9 per cent NaCl in thirty-eight minutes with no detrimental influence = 0.75 gram NaCl per kilo body weight
February 6	7		Acid	0.03	0.05	

It may therefore be concluded that in tartrate nephritis potassium chloride is much more toxic than sodium chloride even though the latter is not excreted to a marked degree.



*The toxicity of potassium chloride in normal rabbits*

As a control of the results of the toxicity of potassium chloride in tartrate nephritis, experiments have been carried through with normal rabbits in which the toxicity of potassium chloride has been determined. In these experiments the technique has been identical with that of the above detailed trials, except that nephritis was not induced. The toxicity of potassium chloride in normal rabbits in a fasting condition may be seen from the results in table 3.

From the results of the three experiments with normal fasting rabbits detailed above it is quite apparent that potassium chloride is just as toxic under these conditions as it is in tartrate nephritis. It is therefore quite evident that the production of tartrate nephritis does not render an animal more susceptible to potassium chloride.

There is thus created a discrepancy between the results of Smillie and those herein reported. The most probable explanation to account for this divergence is in the different lesions produced by the two substances, namely, uranium nitrate (Smillie) and tartrate. The former usually causes an involvement of both the glomerulus and the convoluted tubules, whereas with tartrate the principal action is upon the tubules. On the other hand, if one may use the experiments with sodium chloride as a criterion, this view is somewhat discounted since the damage to the kidneys in these experiments was apparently so great that little or none of the injected chloride was eliminated. It is therefore probable that in the potassium chloride experiments, little opportunity was afforded for the prompt elimination of the salt. Nevertheless, in the experiments with normal fasting rabbits there was no obstacle to rapid excretion of the salt. Potassium chloride however was just as toxic, as it was after nephritis had been induced. The only adequate explanation for the discrepancy in results must therefore reside in the manner of introduction of the salt—oral administration versus intravenous injection.

TABLE 3

*The toxicity of potassium chloride in normal rabbits*

DATE	URINE					REMARKS
	Volume	Specific gravity	Reaction to litmus	Total nitrogen	Chlorides as NaCl	
1920	cc.			grams	grams	
						Fasting rabbit of 1.5 kilos body weight
February 10	17		Acid	0.52	0.07	Water intake, 45 cc.
February 11	69	1.030	Acid	1.58	0.08	Water intake, 100 cc.
February 12	95	1.033	Acid	2.32	0.06	Water intake, 52 cc.
						Injection of 40 cc. 0.9 per cent KCl in ten minutes caused death = 0.24 gram KCl per kilo body weight
						Fasting rabbit of 2.4 kilos body weight
February 16	49		Acid	0.74	0.10	Water intake, 35 cc.
February 17	91	1.040	Acid	1.05	0.10	No water intake
February 18	50		Acid	1.07	0.10	No water intake
						Injection of 90 cc. 0.9 per cent KCl in twenty-three minutes caused death = 0.33 gram per kilo body weight
						Fasting rabbit of 1.9 kilos body weight
February 24	70	1.040	Acid	0.44	0.14	No water intake
February 25	75	1.034	Acid	0.95	0.16	Water intake, 60 cc.
February 26	63	1.045	Acid	0.82	0.12	Water intake, 46 cc.
						Injection of 66 cc. of 0.9 per cent KCl caused death in sixteen minutes = 0.31 gram KCl per kilo body weight

## CONCLUSIONS

Potassium chloride intravenously administered to rabbits with tartrate nephritis is much more toxic than sodium chloride introduced under similar experimental conditions.

Potassium chloride intravenously injected is no more toxic to rabbits with tartrate nephritis than it is to normal animals.

The induction of a nephritic condition in rabbits by tartrate, therefore, does not render the animal more susceptible to potassium chloride introduced directly into the blood stream.

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## UNILATERAL FUSED KIDNEYS<sup>1</sup>

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The comparative rarity of unilateral fused kidney, and its clinical importance, warrants, I believe, the following description of two cases observed within the past two years.

Unilateral fused kidney is one of the most unusual forms of congenital renal anomalies. In this condition, one kidney (the right usually) is transposed to the opposite side of the body where it is fused to the lower end of the left organ, thus forming a single fused kidney (sigmoid kidney). Depending upon the degree of union and its location, three types of fused kidney have been described; the most common form is the horse-shoe kidney, in which the fusion is slight, and generally at the lower pole, one organ being placed on either side of the spinal column. In the second form, the fusion is complete, and the organ is generally situated in the median line; this is known as the disc-shaped kidney. Between these types is the unilateral fused kidney above described. The rarity of this condition may be gathered from the fact that at autopsy the unilateral fused kidney is found but once in over 8000 cases; whereas the horse-shoe kidney is encountered once in approximately 1000 cases. In operative material, the incidence is more frequent, Israel reporting two fused and five horse-shoe kidneys in 800 operations. The reason for such discrepancies lies in the fact, that congenitally dystopic kidneys, on account of anomalies of the blood vessels, and ureters, are more prone to disease than normally situated organs.

Up to within a few years, seventy cases of this anomaly have been compiled from the literature. The diagnosis is seldom made previous to operation or autopsy. In both of our cases, the condition was recognized and an exact clinical and pathological

<sup>1</sup> From the Surgical Service of Dr. Beer, Mt. Sinai Hospital.

diagnosis established on cystoscopic and pyelographic data. The practical importance of recognizing this condition is readily apparent, as errors in diagnosis have resulted in the removal of the single fused kidney in a few instances. The presence of such an organ, especially when ptosed into the pelvis, is likely to lead to unpleasant and dangerous complications during parturition.

The symptomatology of unilateral fused kidney is very vague and misleading. There are no characteristic subjective complaints, in fact there may be no symptoms, unless there is a pathological condition of the kidney itself, or the organ is so placed, as to cause pressure symptoms.

The diagnosis is seldom made by physical examination, for although an enlarged organ may be palpated, the difficulty of interpreting it as a fused kidney can readily be imagined. The diagnosis can only be made with certainty, by a combined cystoscopic and radiographic examination. Cystoscopy alone affords no information, on account of the normal trigonal region. The fused kidney has two ureters which always open normally into the bladder, one on each side of the trigone.

Ureteral catheterization, especially when testing the pelvic capacity may give some clue to the condition, for the patient will feel the pain caused by the distention of both pelvises on the same side of the body. A positive diagnosis can only be made by a pyelogram, or the insertion of opaque catheters.

The surgery of fused kidney is necessarily more complicated and dangerous than that of the normal organ. Still, instances are reported by Albarran, Zuckerkandl and others in which the lower half of the diseased organ was successfully removed. In one of our cases a nephrotomy was performed, the other patient had no pathological condition warranting operation.

*Case I.* Male, age twenty-four years, was admitted to the hospital April 18, 1920. His family and past history were negative. For the past two years, he has had attacks of pain in the left lumbar region, radiating anteriorly to the umbilicus and posteriorly to the spine. The pain never very severe in character, occurred once to twice a week, and lasted but ten to fifteen minutes. These attacks were accompanied by frequent urination and hematuria. The patient was discharged from

the army on account of his trouble, no definite diagnosis having been made.

Physical examination demonstrated a man in good general condition. On abdominal palpation, a mass rounded in contour and of a cystic consistence was felt, extending from the left lumbar region, down to below the umbilicus. This mass was slightly mobile, and at times tender. Liver, spleen and kidneys not palpable. The urine was slightly cloudy, specific gravity 1.020, and showed a moderate number of pus and red blood cells, and also a trace of albumen. The phenolsulphonaphthalein test for two hours observation was 45 per cent; the blood chemistry was practically normal. The radiographic report was as follows: "There is a concretion the size of a cherry in the left lumbar region close to the crest of the ilium, which is suggestive of a ureteral calculus." Cystoscopic examination revealed a normal bladder, trigone and normally situated ureteral orifices. Both ureters were catheterized, and no obstruction encountered. From the right a profuse flow of cloudy urine was obtained, indicating retention in the pelvis. No indigo-carmin was secreted in thirty minutes observation. The capacity of this pelvis was determined by the distention test and found to be 12 cc. The urine from the left side, that is, the side of which the patient complained, and where the stone shadow was noted, was clear, with good indigo-carmin secretion in twenty minutes. The catheterized urines showed the following:

*Right.* Urea 1.0, many pus cells, red blood cells epithelium.

*Left.* Urea 1.5, red blood cells and epithelium.

The result of this cystoscopy left us in doubt as to the exact condition of affairs, for all the symptoms, including the suspected stone shadow were on the left side; while normal urine was obtained from this side, and pathological urine from the right kidney. It was then considered advisable to take a pyelogram of the left kidney, to determine the exact location of the shadow shown in the radiogram. The findings of this examination are shown in figure 1, as a result of which we were of the opinion that the shadow in question was either extra-renal or ureteral, and probably due to a calcified node. A second cystoscopy confirmed the first one. At this time two opaque catheters were introduced, and a radiogram taken, with the result that the paradoxical findings above described were immediately clarified (figs. 2 and 3). This shows the right ureter catheter crossing the spinal column, and coming in contact with the stone shadow, which was situated in the lower pelvis of a fused kidney. This immediately explained the urinary findings from this

side. The left catheter enters the upper pelvis of the fused kidney. A diagnosis was then made of a calculus situated in the lower pelvis of a fused kidney. Operation (Dr. Beer); through a left lumbar incision



FIG. 1.

demonstrated a large kidney situated on the left side of the spine. The organ represented the fusion of both kidneys with a constriction at the junction of the middle and lower thirds. Both pelves came off anteri-



only, the ureter of the upper pelvis, passing anterior to the lower pole. The vessels to the lower pole were derived from either the left common ilias, or the external iliac arteries. A calculus the size of a large cherry

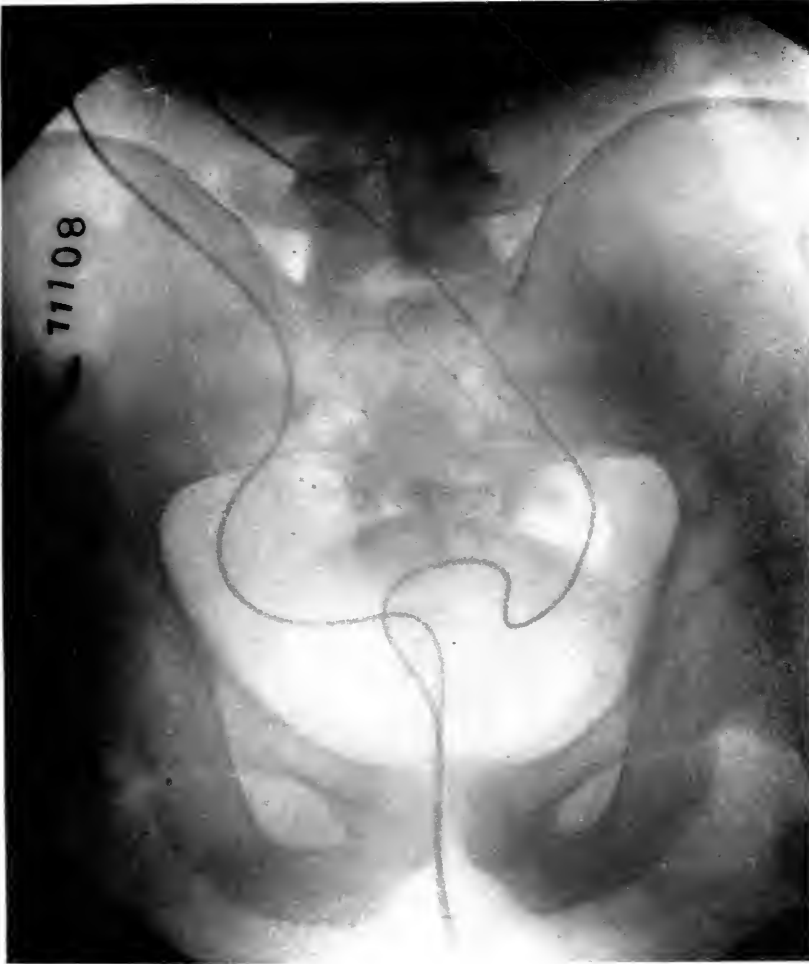


FIG. 2.

was palpated in the lower pelvis, which was opened and the stone extracted. The pelvis was sutured, and the wound closed with drainage. The patient made an uninterrupted recovery and was discharged, well, in a few weeks time. This is one of the few cases reported, in which an

exact preoperative diagnosis of fused kidney was made, and demonstrates how exact a clinical and anatomical diagnosis can be made by utilizing the modern methods which we have at our disposal.

*Case II.* Female, age thirty-two years, admitted to Mt. Sinai Hospital May 20, 1920. Family and past history negative. Complains of a dull pain in the right lumbar region for past four years. Pain does not

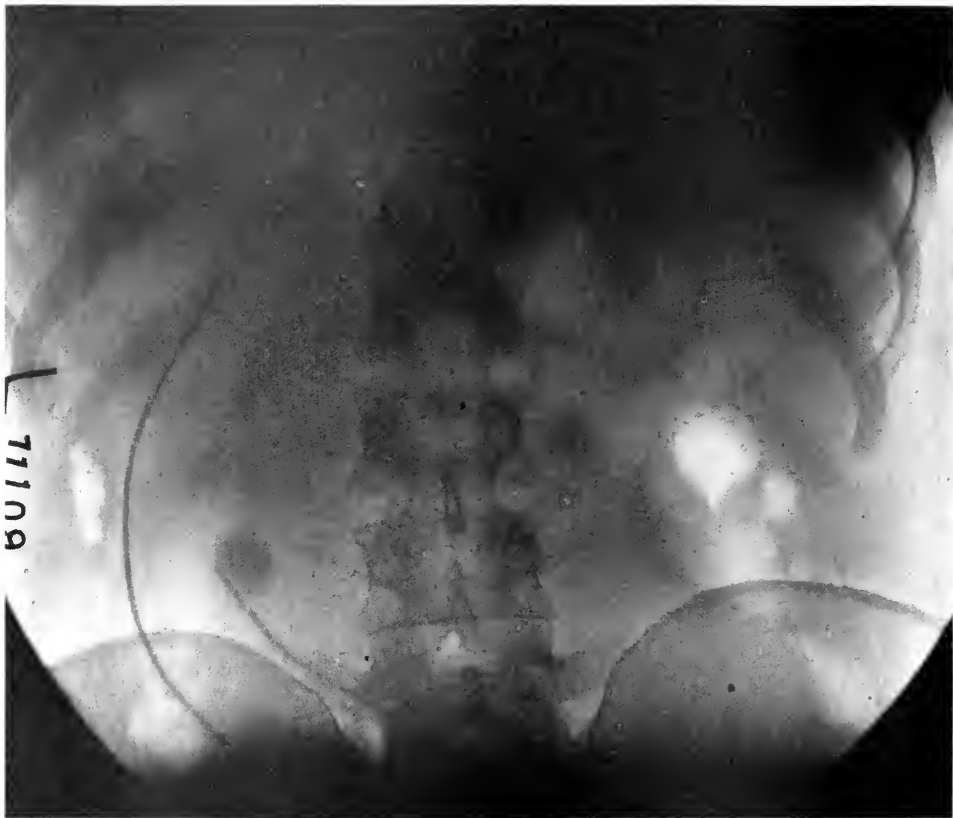


FIG. 3.

radiate, but is aggravated when in the sitting posture. No urinary disturbances.

Physical examination is negative. The abdomen is lax, no masses are palpable. Liver, spleen and kidneys cannot be palpated. Urine—acid—1.018—trace of albumen—moderate epithelial cells. Phenosulphonephthalein test 40 per cent for two hours. Blood chemistry normal.

Cystoscopy demonstrates a normal bladder and trigone, with normally situated orifices. Both ureters were catheterized and clear urine with good equal indigo-carminic secretion was obtained from both kidneys. An X-ray of the urinary tract showed a suspicious shadow in the left



FIG. 4.

lower quadrant of the pelvis, and in order to determine its relation to the ureter radiograms were then taken with two opaque catheters in situ. These showed that the left ureter crossed the spine going towards the right kidney. A pyelogram was taken injecting through both catheters, revealing a fused right kidney, with two separate pelvis (fig. 4).

As far as could be determined there was nothing of a pathological nature besides this congenital anomaly, and the pain was probably due to pressure symptoms. These did not warrant an exploratory operation and the patient was therefore discharged from the hospital.

In both instances, the diagnosis was made by X-rays taken with shadowgraph catheters in situ. In all obscure cases, or when a renal anomaly is suspected, it would seem to be advisable to take radiograms with opaque catheters in both ureters. The information so obtained may prove invaluable.

## SALIGENIN AS A LOCAL ANESTHETIC FOR CYSTOSCOPY IN MEN<sup>1</sup>

ARTHUR D. HIRSCHFELDER, A. G. WETHALL AND GILBERT J. THOMAS

*From the Department of Pharmacology and the Genito-Urinary Division of the  
Department of Surgery, University of Minnesota, Minneapolis*

Although cocaine can usually be used in cystoscopy without the development of unpleasant symptoms, it is, as Macht (1) has shown, absorbed from the urethra with relative ease, and, once absorbed, the dangerous dose is very low. It would therefore be of value to obtain a drug of lower toxicity, provided it could also induce satisfactory anesthesia in the male urethra. Hirschfelder, Lundholm and Norrgard (2) have demonstrated that saligenin ( $C_6H_4OHCH_2OH$  1:2) possesses distinct local anesthetic properties for infiltration anesthesia and that its toxicity is less than one twenty-fifth that of cocaine. Hirschfelder and Wynne (3) have shown that this drug in 4 per cent solutions can be used as a satisfactory anesthesia for cystoscopy in the female.

The drug is made up in 1 gram powders which can be dissolved in 25 mls of water for a 4 per cent solution or in 12.5 mls for an 8 per cent solution. It can be boiled, but should not be autoclaved, as the temperature above the boiling point converts it into a resin.

The drug itself is slightly antiseptic, 2 per cent solutions killing pyogenic cocci in less than half an hour. Solutions can be kept for a week or two without impairment of their anesthetic power.

In order to obtain satisfactory anesthesia the 4 or preferably the 8 per cent solution should be instilled into the urethra and held there from five to ten minutes before beginning the cysto-

<sup>1</sup> The researches described in this report were made possible through the availability of by-products developed in connection with investigations on phenolic alcohols supported by the United States Interdepartmental Social Hygiene Board for the discovery of more effective medical measures in the treatment and prevention of venereal diseases.

*Four per cent saligenin solution (cystoscopic examination by A. G. Wethall)*

NAME	CONDITION	DEGREE OF ANESTHESIA
E. N.	Chronic posterior urethritis	Good
H. N.	Chronic posterior urethritis	Good
H. M.	Chronic posterior urethritis	Good
W. M.	Chronic prostatitis	Good
C. T.	Posterior urethritis	Good
O. S. H.	Cystitis	Good
J. B.	Normal	Good
	Suspected tuberculosis of bladder	Good during passage of instrument
C. G.	Hematuria urethra and bladder	Good
J. S.	Posterior urethritis	Good

*Eight per cent saligenin solution (cystoscopic examination by Dr. G. J. Thomas)*

NAME	AGE	CONDITION	PROCEDURE	RESULT OF ANESTHETIC
A. S. B.	53	Enlarged prostate	Cystoscopy	Very good
J. T.	19	Cystitis	Cystoscopy	Very good
F. J.	54	Kidney stone	Cystoscopy	Very good
M. H.	45	Negative	Cystoscopy	Very good
A. J.	57	Bilateral intravesicular enlarged prostate	Cystoscopy	Good, slight edema at meatus
K. D.	20	Hydronephrosis	Cystoscopy	Good
J. T.	19	Cystitis	Cystoscopy	Good
M. C.	33	Slight prostate	Cystoscopy and cautery	Good
T. A. S.	56	Bilateral intravesical prostate	Cystoscopy	Fair
M. K.	56	Carcinoma bladder	Cystoscopy	Very good
Dr. B.	30	Stricture of urethra	Urethroscopy	Very good
M. P.	52	Papilloma bladder	Cystoscopy	Very good
M. C.	57	Papilloma bladder	Cystoscopy	Very good
J. P.	22	Cystitis-pyelonephritis	Cystoscopy	Very good
M. B.	52	Negative	Cystoscopy	Fair only
M. G.	62	Tuberculosis of chest (suspected tuberculosis of bladder)	Cystoscopy	Good
M. R.	30	Negative	Cystoscopy	Poor (lues?)
M. S.	34	Negative	Cystoscopy	Fair
J. C.	34	Pyelitis	Cystoscopy	Very good
F. H.	41	Bladder stone	Cystoscopy and lithopaxy	Very good

scopic examination. A pledget of cotton wet with the solution should also be kept applied to the meatus for at least five minutes.

In the tabulated cases we have used saligenin in 4 per cent solution, with satisfactory results.

#### CONCLUSIONS

1. In ten cases in which 4 per cent solutions of saligenin were instilled into the male urethra anesthesia satisfactory for cystoscopy was obtained, as was likewise the case in twenty cases in which 8 per cent solutions were used.

2. No unpleasant results were experienced in these cases.

3. Saligenin is a local anesthetic of very low toxicity which can be used satisfactorily for local anesthesia for cystoscopy in the male.<sup>2</sup>

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<sup>2</sup> Since the above article was written an article has appeared by H. H. Young on the Value of Drugs in Urology (*Jour. Am. Med. Assoc.*, 1921, lxxvii, 1327) stating that benzyl alcohol has been used in his clinic but that in some cases it has proved irritating. In our series this has not been the case with saligenin.





## PRESENTATION OF TEST-TUBE HOLDER FOR COLLECTION OF URETERAL SPECIMENS

CHARLES S. LEVY

*From the Urological Clinic, Hebrew Hospital, Baltimore, Maryland*

Many devices for holding test-tubes for the collection of ureteral specimens are employed, but most of these are cumbersome or inconvenient. A test-tube carrier that has been used with considerable satisfaction for the past two years at the

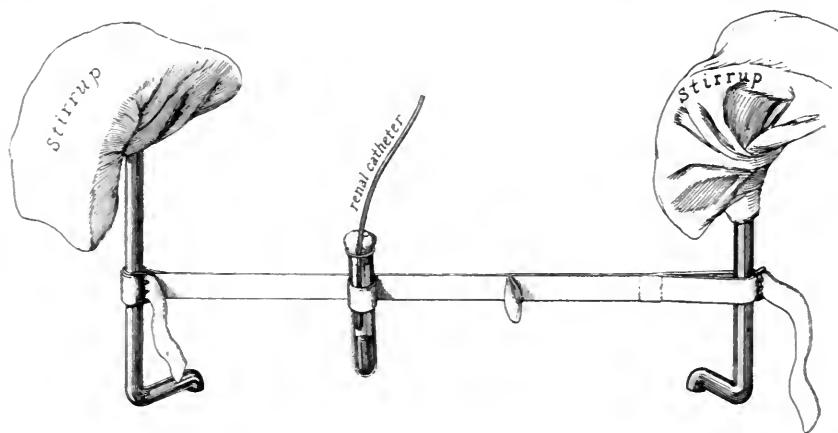


FIG. 1. TEST-TUBE HOLDER ATTACHED TO THE CYSTOSCOPIC TABLE

Hebrew Hospital is herewith presented. It consists of a strap 1 inch in width, attached by buckles to the stirrups of the cystoscopic table. The strap is best made of some non-absorbable material, such as thin rubber sheeting. There are two pockets on the strap which are made of garter elastic to accommodate themselves to any size test-tube or centrifuge-tube. When not in use the strap is released from one stirrup and allowed to hang from the other, and is always at hand for the collection of ureteral specimens.



## AN INEXPENSIVE CARRIER AND RECEPTACLE FOR URETERAL CATHETERS

EMMA C. SCHROEDER, R.N.

On the market there are several carriers, sterilizers and receptacles for ureteral catheters which are expensive and many of them inefficient. We have used the long, glass tubes, with formalin gas as a disinfectant, but these have been frequently broken, are very heavy and hard to handle.

When it becomes necessary for the physician to do his work in several hospitals, it is quite impossible to have a complete supply of catheters of all sizes on hand at just the time that he needs them most.

At the suggestion of Dr. Gilbert J. Thomas, I devised a catheter carrier which is light, transparent, cannot be broken and which can be easily disinfected if necessary. In addition, catheters can be carried without coiling which, in our experience, prevents broken ends, cracks, etc.

Two large X-ray films, 14 inches by 17 inches in size, were rolled and placed end to end, so that one roll was telescoped about 2 inches into the other. The rolls were held together with adhesive plaster, a strip being placed along the outside edge of each roll and parallel with the long axis. The telescoped ends were held together with adhesive. One strip was placed inside to hold the telescoped end to the inside of one roll and another piece was wrapped around the outside to cover the lip of the outer roll. One end of the cylinder was sealed with adhesive plaster. As the catheters might adhere to the adhesive side of the plaster, care was taken to place the smooth side on the inside of the cylinder. The dimensions of a cylinder made in this manner are: length, 32 inches; diameter,  $1\frac{1}{2}$  inches.

A cover for the open end of this cylinder to fit over the end as a cuff, can be made of small pieces of film, held together with adhesive plaster.

At the present time, we sterilize our catheters by boiling just before they are to be used, so that we do not use formalin or any other disinfectant in the cylinder.

The photograph attached gives an idea of the size and method of construction of such a carrier. The cost is very little, as the films which I used were films which had been exposed, the emulsion having been removed with hot water.

We are using a single film roll of 14 inches by 17 inches in size as a container for silk web urethral catheters.

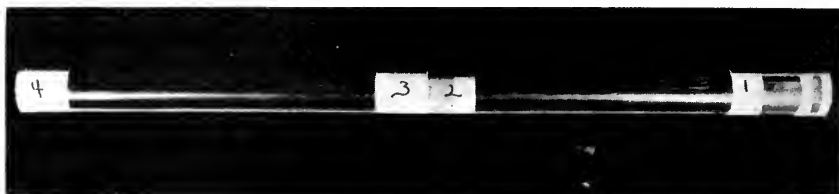


FIG. 1. 1, Cover for open end which fits as a cuff; 2, adhesive plaster which holds the telescoped end of the inside tube; 3, adhesive plaster around the end of the outer tube; 4, sealed end.

## UROLOGICAL IRRIGATOR STERILIZER<sup>1</sup>

ARTHUR B. CECIL

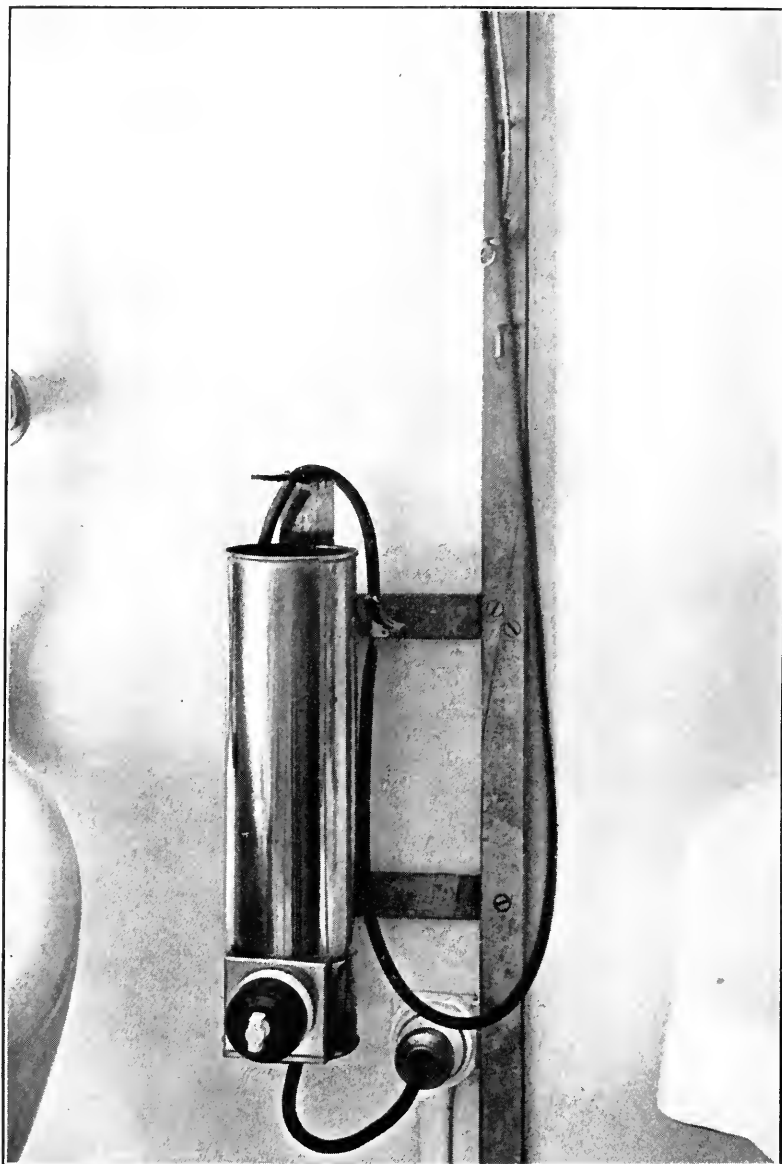
*Los Angeles*

The sterilizer which is to be described is a modification of a sterilizer which was used in the offices of Dr. Hugh H. Young. Dr. Young's sterilizer was gas heated, and greatly facilitated the sterilization of the lower portion of the tube used in irrigations of the urethra, or for filling the bladder for cystoscopic examinations.

The sterilizer which I have devised is electrically heated, has the advantage that should the water boil out of it, it automatically shuts off the electric current, thus preventing damage to the apparatus from undue heat, is extremely compact, and, at the top has been arranged a fork-like apparatus made of "Bakolite" which does not transmit the heat of the sterilizer to the tube. The tube is slipped into this fork which holds it firmly thus preventing the nozzle from being dragged out of the sterilizer when the irrigator is lowered to be filled.

When filled within 3 inches of the top the capacity is 2000 cc. From the top to the bottom the sterilizer measures 17 inches. Its diameter is  $4\frac{1}{2}$  inches. It is constructed of heavy copper fully nickel plated. It is furnished with a multiple heat unit and an ordinary plug for plugging into a 110 A C or D C socket. The switch is fitted with "full," "medium," "low" and "off" divisions. When filled with 2000 cc. of water it boils in twenty minutes, with switch on "full." After bringing the water to a boil the switch is turned on "low," which will maintain the water at a boiling point.

<sup>1</sup>The above sterilizer is manufactured by the R. L. Scherer Surgical Manufacturing Company of Los Angeles, California, and may be obtained from them.



231

# A NEW METHOD OF PERINEAL PROSTATECTOMY WHICH INSURES MORE PERFECT FUNCTIONAL RESULTS<sup>1</sup>

## A PRELIMINARY REPORT

JOHN T. GERAGHTY

*Baltimore, Maryland*

The prostatectomist of wide experience who is fair minded will concede that there are certain well defined indications for both the suprapubic and perineal operations. The popularity of the suprapubic operation, notwithstanding its slightly higher mortality finds its explanation in the more perfect functional results in the hands of most operators, together with the greater experience necessary for skilfull perineal dissection which the perineal method of approach requires. This latter objection to the perineal route however, deserves no serious consideration provided the perineal operation insures greater safety, more satisfactory convalescence and functional results which are equally good.

The object of this paper is to present a method of perineal prostatectomy, simple in its technique which should correct the occasional functional imperfections obtained by the methods now employed. We have observed for a long time that perfect urinary control following perineal prostatectomy could be expected in cases where the prostate was small or only moderately enlarged. When, however, there was great enlargement of the gland which is very frequently associated with a marked stretching of the internal sphincter, a partial incontinence lasting a few months and in an occasional case a permanent loss of

<sup>1</sup> From James Buchanan Brady Urological Institute, Surgical Department, the Johns Hopkins Hospital, Baltimore.

Read at the meeting of American Association of Genito-Urinary Surgeons, Washington, D. C., May 1, 2 and 3, 1922.

urinary control follows the operation. The degree of incontinence varies markedly. Usually when the patient is quiescent the urine is perfectly retained, but on suddenly rising with the bladder full, on coughing or sneezing or any sudden muscular exertion, small quantities of urine escape. This faulty control gradually disappears in most cases and in the course of six months to a year, more or less perfect control is regained.

It is now definitely known that the internal sphincter always lies outside and encircling the adenomatous masses, and consequently in very large prostates there is found marked relaxation and not infrequently atrophy of the fibers of the internal sphincter. This overstretching and atrophy which occurs in the internal sphincter is noted also in the intrinsic musculature of the prostate urethra, so that following the removal of a very large prostate, whether it be carried out by the suprapubic or perineal route, the prostatic urethra and internal sphincter never regain their former caliber and tone. Consequently continence of urine in these cases is dependent upon urethral and extrinsic musculature distal to the apex of the prostate.

It is established with certainty that no matter how large the adenomatous gland or to what degree atrophy of the internal sphincter or intrinsic urethral musculature occurs, incontinence rarely follows suprapubic prostatectomy. This fact has prompted a more careful study of the reason for this temporary difference in functional results following the suprapubic and perineal operations in very large prostates.

In the suprapubic removal of the prostate, the operators manipulations are confined within the prostatic capsule and none of the intrinsic or extrinsic musculature of the membranous urethra should be injured. In the perineal operation, as it is commonly performed, the external sphincter is either dislocated or divided before the membranous urethra can be opened. It may be stated that the technique of perineal prostatectomy usually employed involves the opening of the membranous urethra. The impossibility of exposing the membranous urethra without disturbing the position of the external sphincter can readily be seen by a glance at figure 1, showing the position



of the muscle and its relation to the membranous urethra. All anatomists are thoroughly in accord in their statements that the fibers of the external sphincter surround the entire length of the membranous urethra, even extending for a short distance into the prostate itself. If the membranous urethra is opened without stripping off the surrounding musculature, the fibers of the external sphincter must be divided; if, on the other hand, the muscle which encircles it is dissected forward or backward, considerable injury to this muscle may occur.

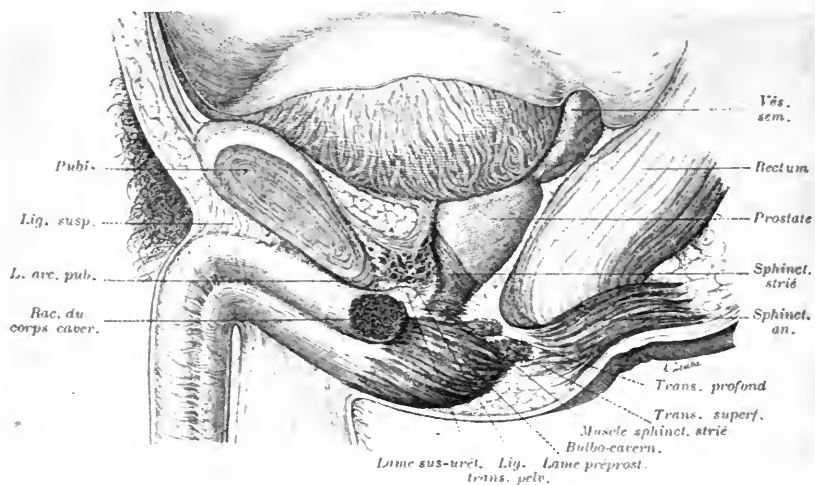


FIG. 1. (POIRIER AND SHARPY.) THIS SHOWS THE POSITION OF THE EXTERNAL SPHINCTER COVERING THE MEMBRANOUS URETHRA AND EXTENDING A CONSIDERABLE DISTANCE ON THE ANTERIOR SURFACE OF THE PROSTATE

It shows the impossibility of exposing the membranous urethra without cutting or dislocating this muscle.

It seems evident that if a method could be developed by which the prostate could be readily and well exposed without danger of injury to the membranous urethra and external sphincter, the occasional faulty functional urinary control following the present operation, especially when done on large prostates, might be corrected.



FIG. 2. (DEAVER.) ANOTHER VIEW OF THE EXTERNAL SPHINCTER SHOWING ITS POSITION AROUND THE MEMBRANOUS URETHRA

When the membranous urethra is opened this muscle must necessarily be injured.

## TECHNIQUE OF OPERATION

The following technique has been carried out in a small series of cases with entirely satisfactory results. The patient is placed in the usual exaggerated perineal lithotomy position. A specially constructed prostate tractor is passed from the meatus into the bladder, the blades of the tractor opened and the handle carried toward the patient's abdomen. This tractor devised by Dr. Henry Freiberg differs from the Young seminal vesical tractor in possessing a curve and shape which facilitates its introduction into the bladder. It furthermore, upon the opening of its blades so engages the prostate that its flat surface rather than the sharp edge is in contact with the gland. This position of the tractor, using the symphysis as a fulcrum forces the prostate forward toward the perineum. A semicircular incision is made, the center of which is about an inch anterior to the anal margin. The ischio-rectal fossae are now opened with the finger and a bifid retractor introduced, each blade of the retractor occupying a fairly deep position in the fossa. When retraction is made, the central tendon is rendered tense and prominent. This structure is then divided close to the bulb, its division exposing the rectum. The rectum is now seen covering a varying amount of the posterior surface of the prostate (plate 1), and the rectourethralis is seen holding the under surface of the bulb to the rectum at a point close to the apex of the prostate. This is not shown in plate. To facilitate the stripping back of the rectum, the finger is introduced anterior and lateral to the apex, the free margin of the rectum being readily picked up at this point. The rectum is now easily and safely freed from the prostate by finger dissection. The fibers of the levator ani are now separated in the midline in the region of the apex of the prostate by blunt dissection. The anterior fibers are now pushed laterally while those covering the body of the gland are pushed backward. The smooth, glistening visceral layer of Denonvilliers fascia is now exposed. It is evident from the foregoing description that the membranous urethra is not exposed and its musculature undisturbed.

A curved incision is made through the posterior layer of the prostate, the point of the curve being at the apex of the prostate and the legs extending downward in a divergent manner as shown in plate 2. The form of this incision preserves the flap containing the ejaculatory ducts and furthermore gives a maximum exposure of the hypertrophied lobes beneath. The line of cleavage between the capsule and the adenomatous masses is affected by the blunt dissector and the subsequent dissection carried out with the finger as is done in the suprapubic enucleation. The finger is carefully and gradually insinuated between the two layers, the anterior or apical portion of the lobes being delivered first. This facilitates the subsequent removal of the deeper portions of the gland especially the part which lies within the bladder. After the delivery of the apical portion of the lateral lobes, these portions are grasped with forceps, traction being then made. The suburethral and intravesical lobes are then carefully freed from their posterior attachment and from the grasp of the internal sphincter. If following the removal of the adenomatous mass which is usually possible in one piece, as recommended by Hinman (1) and Young (2) unusual bleeding is present, the mucous membrane edge is grasped with forceps and any bleeding vessels ligated. A large single tube is now introduced into the bladder through the opening of the prostatic capsule. Long strips of gauze are now packed tightly around the tube to a point well within the vesical orifice. The prostatic cavity is next snugly packed, the gauze being guided into its proper position by the finger.

It is well recognized by most prostatectomists that the most serious hemorrhage following prostatectomy arises from large vessels which lie in the overhanging flap of bladder wall from which the prostate has been separated. If care is not exercised in packing from the perineal side, this lip of bladder wall may be everted into the bladder cavity, and no hemostasis effected at this point by pressure of the pack. This accident may be avoided by grasping the edge of the overhanging lip of bladder wall with a mucosal clip, thus fixing it until the gauze pack has been inserted between the tube and vesical orifice. The obser-

vance of this technique will prevent eversion of the torn edge of the bladder and possible serious intravesical hemorrhage.

The tube is now sutured in the skin edge with heavy silk and the remaining portion of the skin incision approximated with subcuticular chromic catgut.

#### CONCLUSION

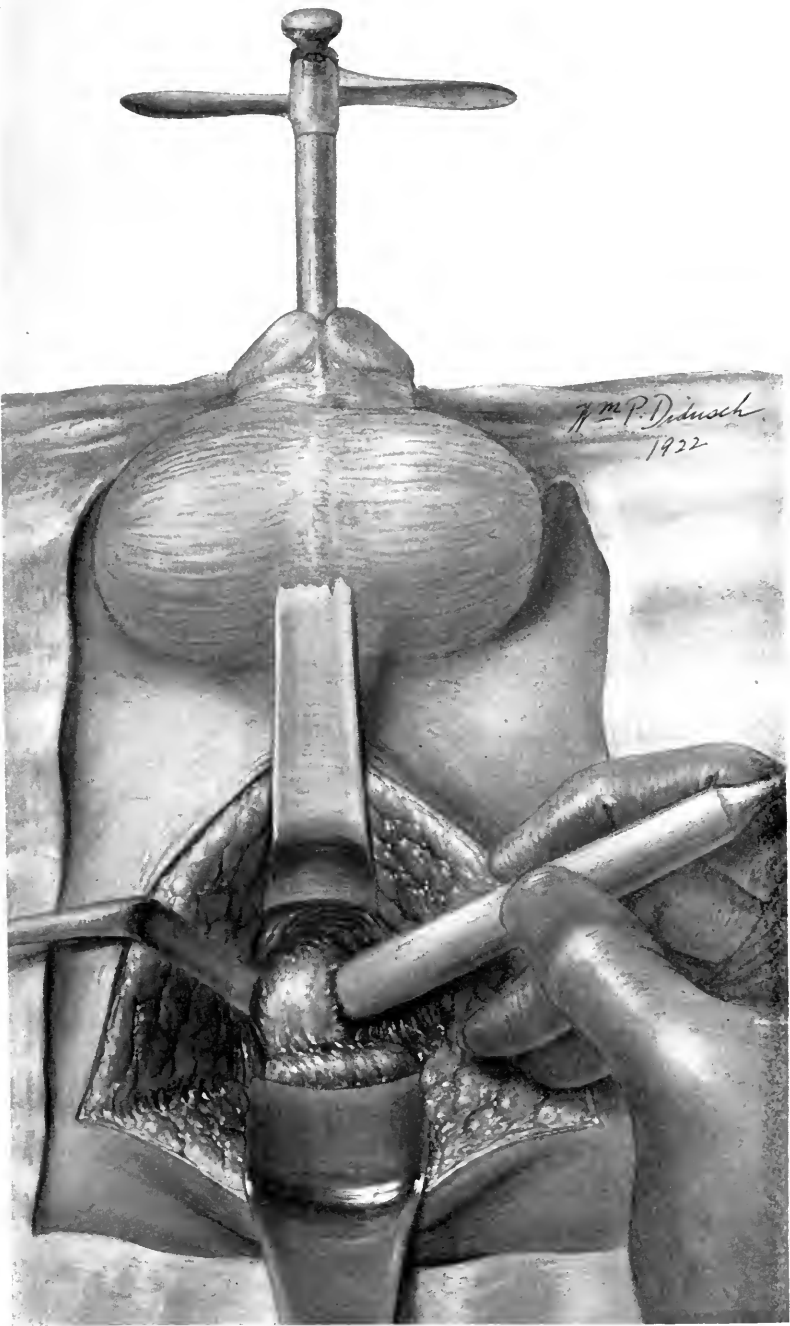
The operation described above has been carried out in a series of 10 consecutive cases. The exposure of the prostate by the technique above outlined simplifies rather than complicates the dissection. The method proposed differs essentially from the technique described by Young in that the membranous urethra is not exposed or at any time in the field of operation. Its intrinsic and extrinsic musculature as well as the nerve supply are neither disturbed nor injured.

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- (2) YOUNG: Jour. Amer. Med. Assoc., April 1, 1922.

#### PLATE 1

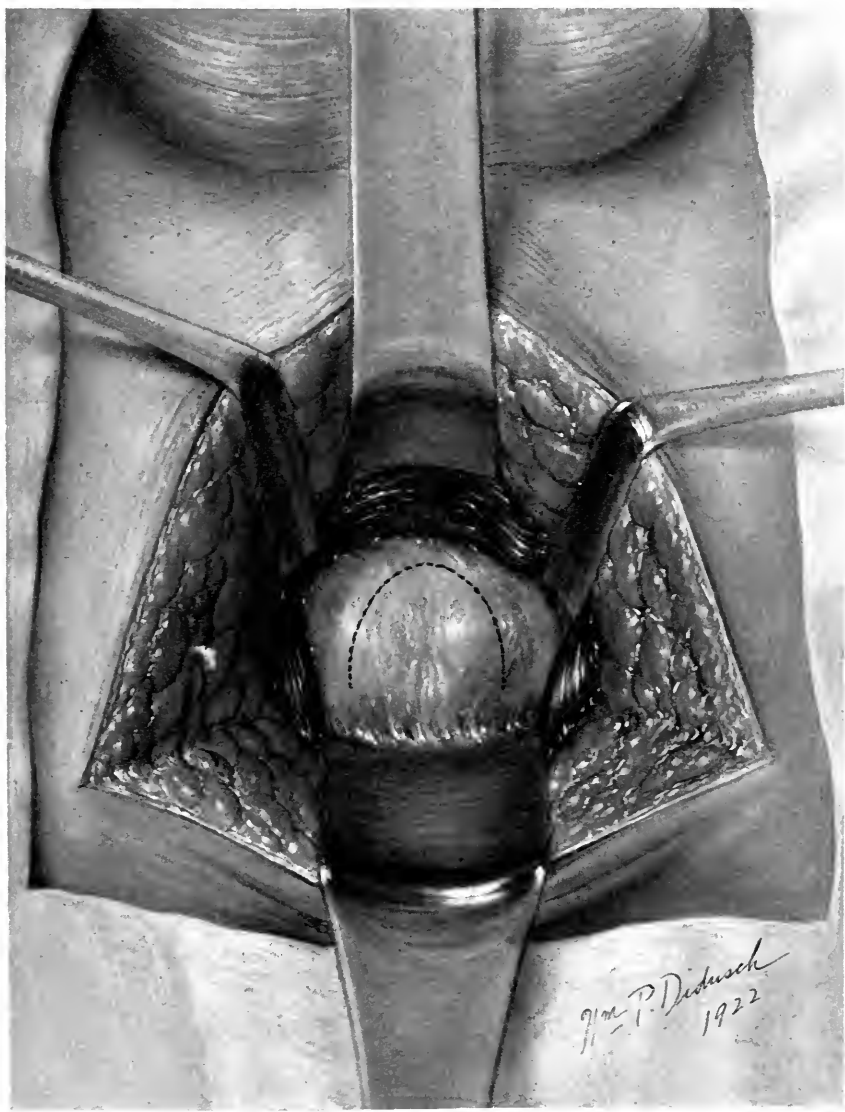
The skin incision has been made and the recto-urethralis muscle divided. The rectum is shown in the bottom of the wound and the handle of the knife is stripping to either side the levator fibres that cover the prostate.



## PLATE 2

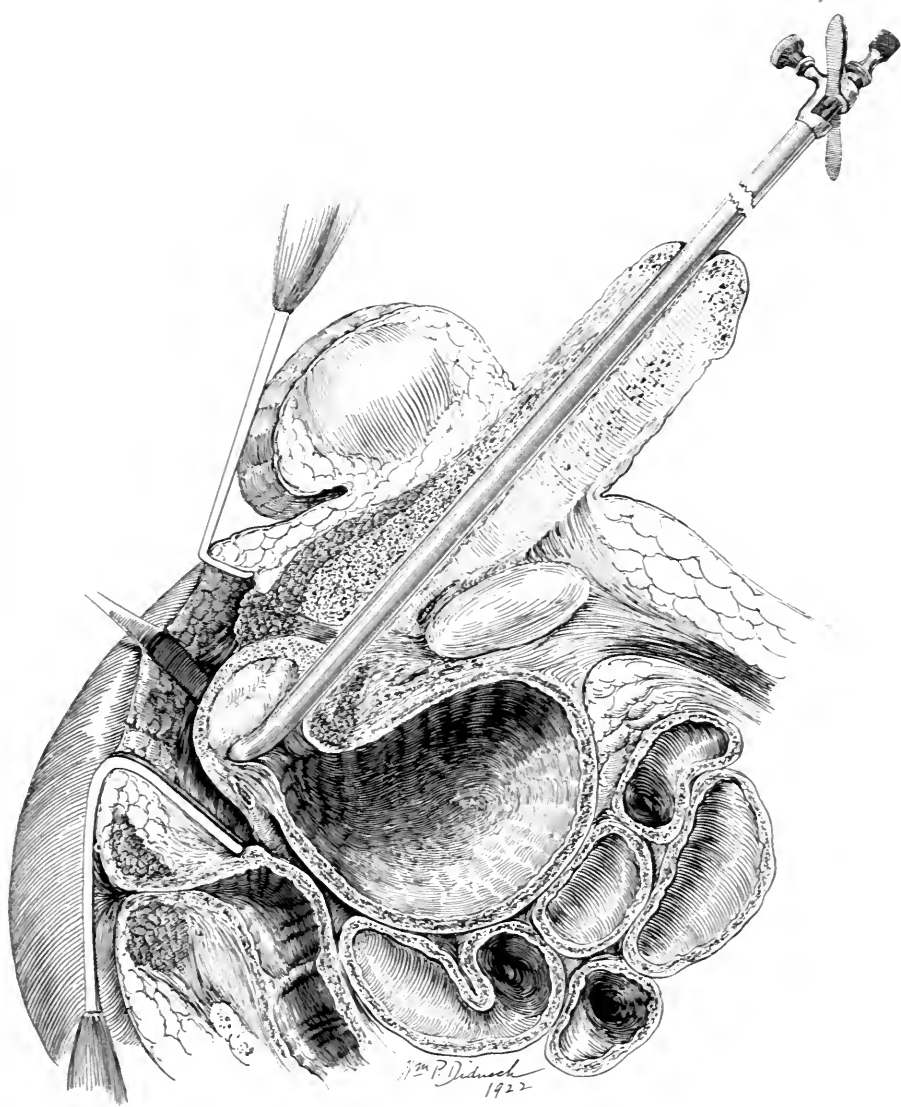
The rectum is drawn backward, the levator muscles drawn outward and downward, thus exposing the posterior surface of the prostate. An inverted V incision is now made and the enucleation of the prostate carried out in the usual manner.





### PLATE 3

A sagittal section showing the tractor in position and the relation of the rectum and membranous urethra to the prostate, forced into a new position by the tractor.





## DIVERTICULA OF THE BLADDER<sup>1</sup>

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*Boston, Massachusetts*

The advent of the cystoscope has brought out the relative frequency of diverticula of the bladder and has made possible the permanent relief of many sufferers that otherwise would not have been improved. It might seem to one not initiated that it would be perfectly simple with a bladder opened to detect the opening of a diverticulum. On the contrary it would be very easy, even with the inner walls of the bladder before you, to miss the small opening into a large diverticulum. It is easy to see how one doing a two stage prostatectomy might entirely miss the presence of a large diverticulum. We have to depend on the cystoscope and on cystograms to detect this lesion with surety.

A large part of the early work on diverticula was done by Germans. On the other hand it has been for the Americans to perfect the operative technique for its complete relief.

The work of Englisch, Pagenstecher and Wagner stand out particularly in the early work done. The Germans conceived the idea that one could detect whether a diverticulum was congenital or acquired, by examination of the walls of the diverticulum. The congenital ones were supposed to have all the layers of the true bladder wall while the acquired ones had a wall only of fibrous tissue covered with epithelium. The classification has not been borne out by later observers. Thomas in the report of cases in the Mayo Clinic was able to make no such differentiation. I personally have had an opportunity to examine histologically quite a number of diverticula and in none of them have I found the walls of the diverticulum corresponding

<sup>1</sup>Read at the meeting of the American Association of Genito-Urinary Surgeons, Richmond, Va., May 2 and 3, 1921.

to the walls of the true bladder. In the first place the mucous membrane consists usually of a very thin layer of pavement epithelium and in cases where there was much sepsis the epithelium was entirely lacking in many places. The walls were composed mostly of fibrous tissue with only scattered smooth muscle fibers. In no place were definite muscle bundles seen as there are in the true bladder wall.

There has been a great deal of argument pro and con as to whether diverticula are congenital or acquired. Many feel that there is a weakness of the bladder wall that gives way in the face of back pressure. Watson of Buffalo describes a theory for the formation of congenital pouches which may form diverticula. His observations were made on fetal bladders. In the pouches described by him the walls had all the coats of the true bladder. It seems far fetched to me. Why if a diverticulum starts with a wall that corresponds to the bladder wall should it lose this wall? Then too why should not the muscles in the wall of the diverticulum hypertrophy and form trabeculations on the wall of a diverticulum?

Thomas finds obstructions to the outflow of urine in 86 per cent of the cases of diverticulum in the Mayo Clinic and concludes from this that obstruction is a causative factor in the formation of the diverticulum. I feel firmly convinced that all diverticula are congenital and that attention is only brought to them by the presence of obstruction or infection or both. Just because obstruction is present does not prove that the obstruction caused the diverticulum. Doubtless where obstruction is present the diverticulum increases in size, but I feel that there must have been a definite sac to start with. The puckered opening into a diverticulum is so distinct and is so different from the small pits or cellulae one so often sees in a much trabeculated bladder that I cannot conceive of one of these pits enlarging and becoming a true diverticulum.

As is well known a diverticulum is inelastic and unable to empty itself so that there is always a puddle of urine left. Infection started from any cause in such a bladder never clears up until the bladder can drain itself. I have lately seen two cases

of double diverticula in young men without obstruction. In both cases the diverticula were found as a result of cystoscopic examination, to find the cause of turbid urine continuing after a gonorrheal infection.

There are certain localities in the bladder that are favorite spots for diverticula. The most common spot, as noted first I think by Pagenstecher, is in the lateral walls in close approximation to the ureteral orifices. Another place is in the region of the urachus, though this is not nearly as common as on the lateral walls. It is rare to find diverticula elsewhere in the bladder. It has been suggested that occasionally a pelvic abscess, such as caused by a diverticulitis of the sigmoid might rupture into the bladder with the formation of a diverticulum at the sight of abscess. I saw a case four years ago that I suspected might be of this nature. The opening was high up on the left side of the bladder well away from the ureteral orifice. The patient was a man of forty-five years. He gave a history of having had inflammation of the bowels when twenty. This was followed by passing what he describes as fecal material through the urethra for three months. As this case has never submitted to operation there is no way of verifying this. Pagenstecher also noted that diverticula were very apt to be bilateral and also that they were more prevalent on the left side, and that where they were bilateral the larger one was usually on the left side. In the three cases that I report the diverticula were bilateral, and in all the larger was on the left side.

Cystograms are of importance in making the diagnosis; Lerche in 1911 first makes mention of taking radiographs in various positions in order to get a better idea of the size of the diverticulum. If a diverticulum lies posterior to the bladder you will not get much of it in an antero-posterior view, whereas by tipping the patient partly on one side most of the diverticulum will be brought into view. This is well shown in some of the lantern slides that I will show.

Lerche also brought out the ingenious idea of introducing a rubber bag on the end of a ureteral catheter and distending the bag with boric solution to determine the size of the diverticulum.

He also used this bag to distend the diverticulum at the time of operation.

Papilloma, cancer, stones and angioma have all been found in reported cases. Von Blum in a recent excellent monograph on diverticula reported a case in which there had been severe bleeding. At operation he found a large angioma in the sac. Thomas mentions the prevalence of pyelonephritis. This, of course, is to be expected. Given an infected urine plus a large residual and the answer is sure to be pyelonephritis in varying degrees.

Hinman suggests the possibility of a diverticulum forcing its way between the rectum and the prostatovesical region and thus causing obstruction at the bladder outlet, much the same as an enlarged prostate might do. This sounds reasonable, and it seems to me that retention is much more likely to happen in the presence of acute infection.

The treatment for relief of a diverticulum is of course surgical and complete excision is the only hope of complete relief. The hope of radical cure at times has to be modified by the patient's condition. In 1896 Czerney reported the first radical cure.

Various operations have been devised but the one that has been most successful and the one now in most common use is the extra-peritoneal complete excision through the opened bladder. The transperitoneal route carries with it too much danger of peritonitis as the infection in the bladder in some of these cases is very foul.

Any attempt to enlarge the opening of the diverticulum so that it will drain better accomplishes very little, except perhaps in the case of an hour glass bladder such as Squier reports, which really is different from the ordinary diverticulum. The walls of the diverticulum being inelastic rendered any attempt to make the diverticulum and bladder one cavity of little avail. Drainage of the bladder by a suprapubic tube is often a necessary preliminary step just as it is in prostatectomy, but no hope of permanent relief can be hoped for in this way. Dyas reports a case of a large diverticulum in which he opened the bladder and put a drainage tube through the bladder into the diverticulum



and left it there for ten days. I do not see how he could get more than temporary benefit from the drainage. It seems to me that the only reasonable palliative operation advisable in cases where a complete teresection is out of the question on account of the patient's condition or on account of the extreme difficulty in freeing the diverticulum is to remove as much of the fundus of the diverticulum as possible outside of the bladder and then put a drain into the diverticulum outside the bladder. Then from inside the bladder refresh the edges of the opening of the diverticulum into the bladder and sew these edges together. In this way you not only get the drainage of the diverticulum, but there is a chance of obliterating it entirely.

Lower in 1914 described a method of packing the diverticulum with gauze before attempting to free it. Making the diverticulum a semisolid body certainly makes it more easily separated from the surrounding tissues. I have found it of great help.

The method described by Young of using an electric suction pump and everting the diverticulum into the bladder is very ingenious. I have not tried it, but I should think that in some cases the walls of the diverticulum would be so adherent that they would not respond.

The method that I have used is to make an incision from the pubes to the umbilicus down to the bladder, which is filled with solution. The bladder is then mobilized, especially on the lateral walls. After that has been done the bladder is opened and the openings of the diverticula made out and explored. Ureter catheters are then passed and left in during the operation, as described by Beer. I have found it a great help to know at all times where the ureter was, as in the cases I have done the ureter lay very close to the sac of the diverticulum. Of course, if the ureter lay very close to the sac of the diverticulum. Of course, if the ureter opens into the diverticulum this cannot be done at first. The diverticulum is then packed with gauze and is freed outside of the bladder by blunt dissection usually with the fingers. I have found that this works well for the freeing of the fundus of the diverticulum, but that to free the last tissue about the neck of the diverticulum it is easier to remove the gauze and

evert as much as possible of the diverticulum into the bladder and then work with the fingers outside the bladder and the thumb inside the bladder at the outlet of the diverticulum grasping the wall of the diverticulum between the thumb and the forefingers.



CASE 1

In this way the last of the adhesions can be freed. When the diverticulum is entirely freed it is excised at the neck and the cut edges brought together with chromic catgut sutures. The bladder is closed to a suprapubic tube and rubber dam drainage placed outside the bladder to the site of the diverticulum.

During the past year I have operated on three cases of diverticulum of the bladder that I would like to report briefly. All three cases were double and the openings of the diverticula were similarly placed, in all three. The openings were just above



CASE 1

and slightly to the outside of the ureteral orifice. In all three the larger diverticulum lay on the left side.

*Case 1.* A man of fifty-one. No urinary trouble until nine years ago when he contracted gonorrhea. Ever since then he has had an irritable bladder. Two weeks before I saw the patient he began to

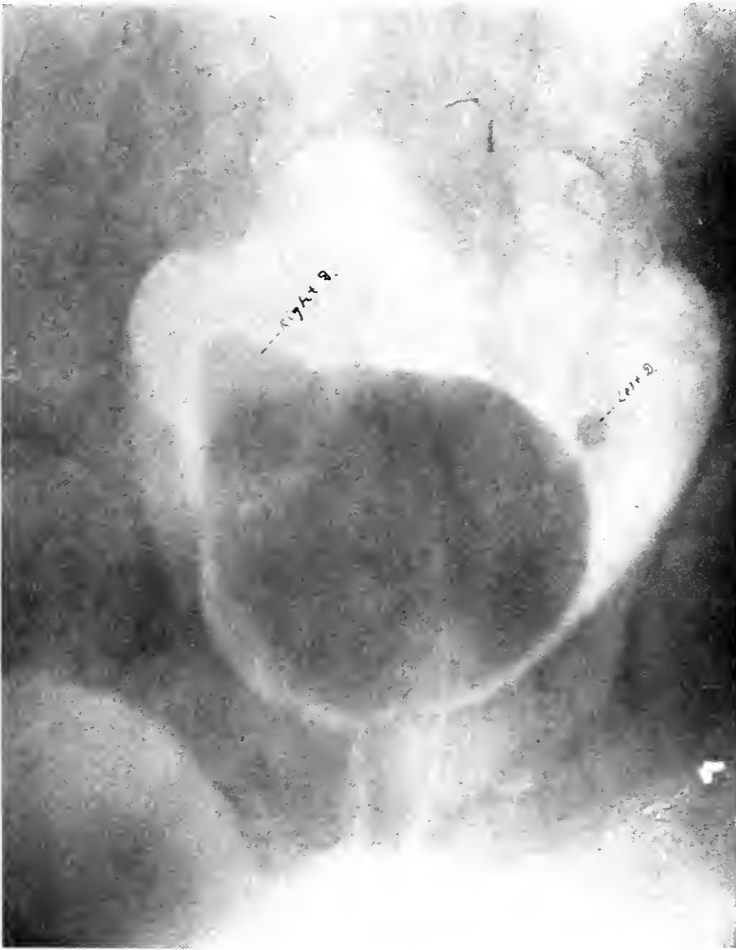
have marked increase in frequency and dribbling. His local doctor catheterized him several times and each time found a large amount of urine in the bladder. At the time I saw him he had complete retention. His prostate was not enlarged by rectum. His reflexes were good, and



CASE 1

he was in good general condition. On passing a catheter, with no difficulty, 30 ounces of turbid, foul smelling urine was drawn off. I then introduced a cystoscope and at first was at a loss to interpret what I saw. The cystoscope was in a large cavity with smooth glisten-

ing walls that in no way looked like bladder mucosa. I was unable to find either ureter. On the floor of the cavity, some stuck to the walls, were several small stones. On withdrawing the cystoscope to look at the bladder outlet the cystoscope suddenly passed into another cavity



CASE 2

which proved to be the bladder. The cystoscope had at first been in the left diverticulum. An opening of another diverticulum was then seen just above and outside the right ureter. The cystograms taken show the relative size of the diverticula. After a week's drainage by

catheter I operated on him and removed both diverticula. The one on the left was very large and adherent to the rectum. There was considerable bleeding. The bladder outlet, it was noted, was very tight.



CASE 3

This was dilated, but it did not seem wise to attempt anything radical at this time. After the bladder had healed this man still had a residual of 9 ounces. I then removed a small fibrous prostate by the

perineal route and he was able to empty his bladder completely. I feel sure that in this case the infection in the diverticula had some effect in producing his complete retention.



CASE 3

*Case 2.* A young man of twenty-four who had never had urinary trouble until three years ago when he had gonorrhea. He has been troubled with frequency ever since. He has constantly been under treatment for chronic gonorrhea on account of the urine remaining turbid and containing a large amount of pus. He had had a complete

course of sounds and massage. At no time was there evidence of stricture. Cystoscopic examination showed a residual of 4 ounces of turbid urine. The whole bladder mucosa was injected. The diverticula openings were seen, one just above and outside each ureteral orifice.



CASE 3. LARGE DIVERTICULUM ON LEFT

The cystograms show the relative size of the diverticula. The larger one on the left. These diverticula were resected. At the end of two months the urine was clear and there was no residual.

The third case was in a woman of fifty-five who had had a bladder stone removed through the vagina seven years before. She has been



troubled with frequency ever since. One week before I saw her she had acute retention and had to be catheterized since. Cystoscopic examination showed considerable cystitis. Just above and to the outside of each ureteral orifice was the opening of a diverticulum. The urine was turbid and contained a large amount of pus. Cystograms showed two diverticula, the larger on the left. After a week of catheter drainage both diverticula were resected. The patient is now free from symptoms and empties her bladder completely.

Cases two and three undoubtedly had had the diverticula always but they had had no symptoms until infection called attention to it. In case one there was obstruction to the out-flow of urine, but I doubt very much if it had anything to do with the formation of the diverticula.

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## SPHINCTEROTOMY PER URETHRAM

### A SIMPLE AND SAFE PROCEDURE FOR THE CURE OF CONTRACTURE OF THE VESICAL ORIFICE

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Contracture of the vesical orifice as a fairly frequent cause of urinary obstruction is now well recognized. This condition was described in the earlier French literature as "prostatism sans prostate" and in more recent years has been referred to as prostatic median bar obstruction. These terms are intended to refer to a condition which is the result of an inflammatory process and not to obstructions resulting from prostatic adenomas. A pathological study of the lesion now commonly described as "median bar" or "prostatism sans prostate" shows it to be a fibrosis of varying depth involving the vesical orifice particularly in its posterior portion. Microscopic examination of tissue from these cases shows a fibrous infiltration which practically always involves the muscle fibers of the internal sphincter. This inflammatory infiltration diminishes sphincteric relaxation and results in a narrowing of the vesical outlet during the act of urination. This narrowing of the orifice rarely approaches the diminished calibre of strictures found in other portions of the urethra and rarely, if ever, offers obstruction to the passage of fair sized instruments.

In a considerable series of these cases the bladder has been opened suprapubically and the vesical orifice very carefully examined. In every case a narrowing of the orifice has been present and in no instance was a bar formation found to explain the obstruction, (Randall). It was found, moreover, in every case that simple division of the internal sphincter in the midline posteriorly resulted in an immediate relaxation of the orifice with complete and permanent relief of obstruction.

Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, D. C., May 1, 2 and 3, 1922

If one excludes the suprapubic approach there are three methods employed at the present time for the correction of contracture of the vesical orifice—the modified Bottini operation of Chetwood, the Young “punch,” and the cautery “punch” recently suggested by Caulk. All of these procedures while accomplishing a satisfactory end result are not infrequently followed by prolonged sloughing and serious hemorrhage.

The results following mere division of the sphincter were so brilliant that the possibility of carrying out this procedure in a safe and simple manner per urethram was suggested.

The instrument employed for dividing the sphincter is shown in the accompanying figure. It consists of a wedge shaped con-

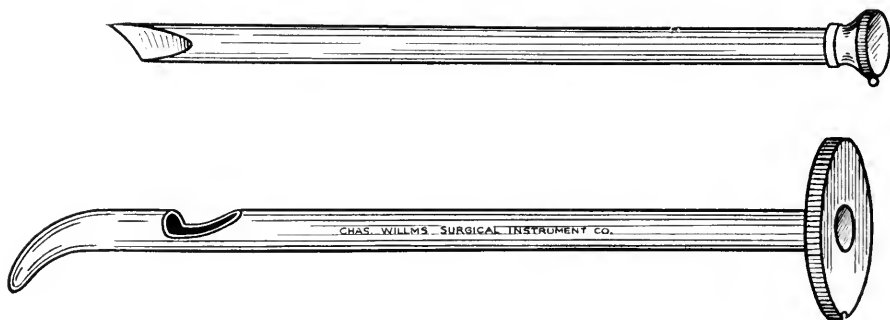


FIG. 1

cave knife which accurately fits a F-28 endoscopic tube similar to the outer sheath of the Young punch.

The technique of the operation is as follows: The patient is prepared as for cystoscopy. The anterior and posterior urethra are anesthetized with a 4 per cent Procaine solution and the bladder filled with 200 cc. of water if possible. The sheath with its obturator is passed after which the latter is withdrawn. After the removal of the obturator the sheath is withdrawn until fluid ceases to escape which indicates that the fenestra has engaged the vesical orifice. In rare instances where the trigone is markedly hypertrophied the ligamentum interuretericum may engage the fenestra. This may be readily recognized by rotating the instrument 90° when water will begin to escape unless the fenestra lies at the level of the orifice. The vesical orifice now

being engaged in the fenestra the knife is introduced and the fibrotic ring divided. In cases in which it is desirable to incise deeply, especially when the fibrosis is unusually thick, a forked spear lifts the fibrous ring into the fenestra. While the spear mobilizes the tissue to be incised the knife is then passed and a deeper cut obtained. This procedure will only occasionally be necessary.

The operation is extremely simple, requiring but a few minutes in its execution. It is further practically painless, causing no more discomfort than the average cystoscopy. It is followed by very slight oozing and in none of the cases operated upon has the urine been any more than blood tinged. It has been unnecessary therefore to introduce a retention catheter, which is nearly always required in the other methods employed.



## THE STRUCTURAL BASIS FOR CONGENITAL VALVE FORMATION IN THE POSTERIOR URETHRA<sup>1</sup>

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The early recognition of congenital obstruction to urination in the male child is a matter of paramount importance if therapeutic measures are to be followed by any appreciable benefit. Fortunately the congenital narrowings of the urethra that possess a definite clinical bearing and importance are very few. The partial occlusion of the urethra from a membrane across the external meatus and also from a densely adherent foreskin are so readily recognized and remedied that they become of only passing clinical interest. Within the urethra itself, however, obstructions may pass unrecognized for months and even years and when once they are suspected they are usually next confirmed at the post mortem table.

This communication deals with the developmental basis for the most common anomaly of the posterior urethra, which malformation is due to a hyperplasia of the lower portion of the colliculus seminalis and especially the inferior striae proceeding therefrom to form a membrane or valve which more or less completely obstructs the flow of urine.

Clinical studies of such cases, all confirmed by autopsy findings, have been reported in this country by Knox and Sprunt (1), Jordan (2), Lowsley (3) and Silverberg (4). More recently Young, Frontz and Baldwin (5) have given us a very complete review of the reported cases and added twelve of their own studied in detail. In Europe Valpeau (6), Tolmatschew (7), Schlagenhauer (8), Commandeur (9), Bazy (10), Wilckens

<sup>1</sup> Read before the Section on Urology at the Seventy-second Annual Session of the American Medical Association, Boston, June, 1921.

(11), Englisch (12) and others observed and reported this condition before American urologists began to recognize or appreciate its clinical importance.

Concerning the origin of the valve-like formation at the distal extremity of the colliculus seminalis there is relatively little accurate information. Numerous observers however have given us many and varied views as to its genesis. Its occurrence in the very young and its recognition during the first weeks or months of life have made all practically agreed upon its congenital origin. Wilckens states that the condition is due to an over-development of the normal folds of the urethra (inferior striae), which process coincidentally causes a narrowing of the urethra at this site, and that the valves once started become greater from the pressure of urine.

Posner (13) and Lederer (14), on the other hand, are inclined to regard the condition one of arrested development. Lederer states that its occurrence at the point of union of the entodermal and ectodermal portions of the urethra should support this view. However, the question of origin of the different portions of the urethra is not as yet a settled matter. Felix (15) in his splendid monograph in Keibel and Mall's *Human Embryology* contends that the entire urethra from the colliculus seminalis to the coronary sulcus arises from the urogenital sinus and is entirely of entodermal origin. Certain other investigators, notably Broman (16), believe that the corpus cavernosum develops entirely from the ectoderm, arising from the cloacal plate or ridge.

Knox and Sprunt in discussing the first reported American case conclude that they are dealing with a simple progressive malformation and not an arrested development. Lowsley in commenting upon his case states that the condition seems to be an anomaly in the development of the Wolffian and Müllerian ducts rather than a defect in the urethra itself. Later, however, he minutely describes the anomalous attachment of the fibers of the inferior striae about the entire circumference of the urethra instead of only along the urethral floor as is normally the case. This observation appears to focus our atten-



tion more on the lower margin of the colliculus than on the Wolffian ducts or sinus pocularis.

As has been described in detail elsewhere (17) the colliculus seminalis has its origin from the so called Müller's tubercle or hillock of Müller situated on the floor of the urogenital sinus. In its earliest stages it is composed of undifferentiated mesenchymatous cells and covered with simple columnar epithelium.

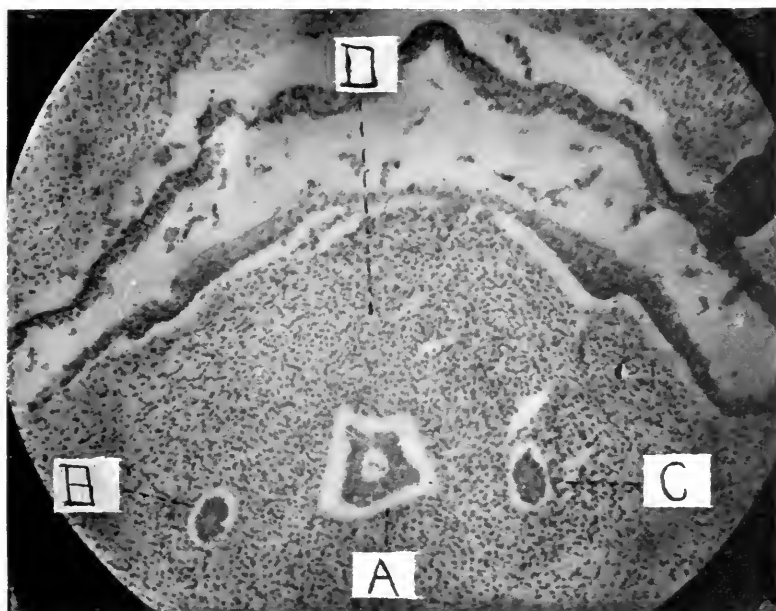


FIG. 1. CROSS SECTION THROUGH VERUMONTANUM. FETUS THIRTEEN WEEKS OLD

A, prostatic utricle; B, left ejaculatory duct; C, right ejaculatory duct; D, substance of the verumontanum (undifferentiated mesenchyme).

At this time, about the thirteenth week of fetal life, it contains the paired Wolffian ducts which course through it and open at its summit into the posterior urethra and the prostatic utricle or sinus pocularis (fused Müllerian ducts), which at this time is a closed hollow sac. Proceeding from the lower portion of the colliculus are three slim ridges, the inferior striae, which gradually decrease in size as they traverse the floor of the urethra until they become lost in its undifferentiated mesenchyme.

The verumontanum at this period possesses no glandular elements but the ejaculatory ducts are well formed and open boldly into the posterior urethra. In many places the epithelium covering the veru is in close apposition to the similar cells lining the urethra itself.

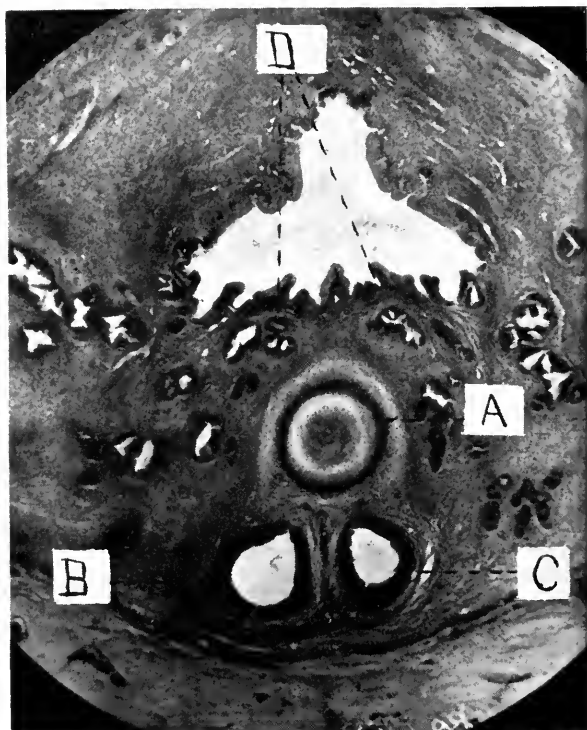


FIG. 2. CROSS SECTION THROUGH VERUMONTANUM. FETUS TWENTY-ONE WEEKS OLD

*A*, prostatic utricle; *B*, left ejaculatory duct; *C*, right ejaculatory duct; *D*, glands of mucous membrane origin—above which are many indentations (new glands in process of formation).

In the course of other work on the development of certain accessory structures along the lower urinary tract certain specimens have been encountered the study of which has seemed to throw additional light on the etiology of the so-called valve formation in the posterior urethra.

As has been pointed out in previous contributions (18) the colliculus seminalis has numerous inherent gland tubercles which may be divided into three groups, those of mucous membrane origin, those of prostatic origin, and those arising from the prostatic utricle. The glands of mucous membrane origin are

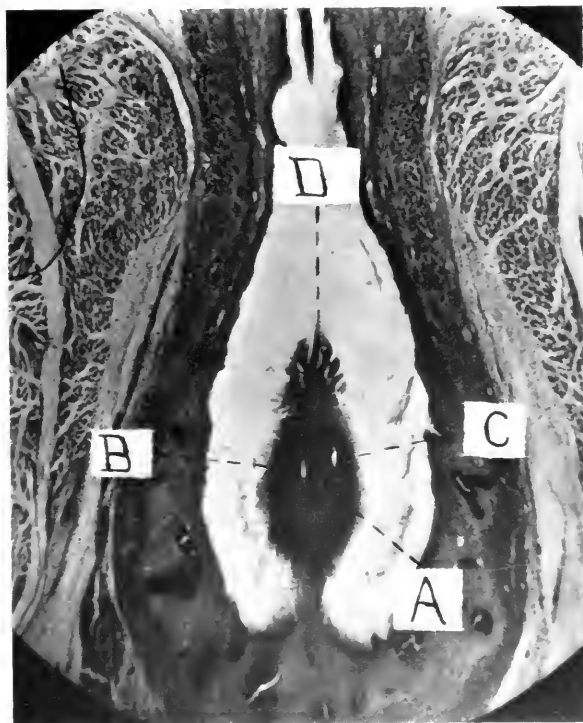


FIG. 3. CROSS SECTION THROUGH VERUMONTANUM. FETUS FOURTEEN WEEKS OLD

A, prostatic utricle; B, left ejaculatory duct; C, right ejaculatory duct; D, beginning formation of the glands of mucous membrane origin (forming from invaginations of the mucosa).

first noted during the fourteenth week of fetal life. They are all located along the periphery, and for the most part in the most posterior portion of the colliculus. Coincident with the appearance of the above glands there is a marked proliferation of the surface epithelium. This increase of the cellular elements may fill the space between the top of the colliculus and the roof of

the urethra. Pressure upon this portion of the urethra from without, probably augmented by chemical changes the nature of which as yet we know very little, causes a definite disintegration of the mucous membrane upon the surface of the colliculus and also along the roof of the urethra. This is evidenced

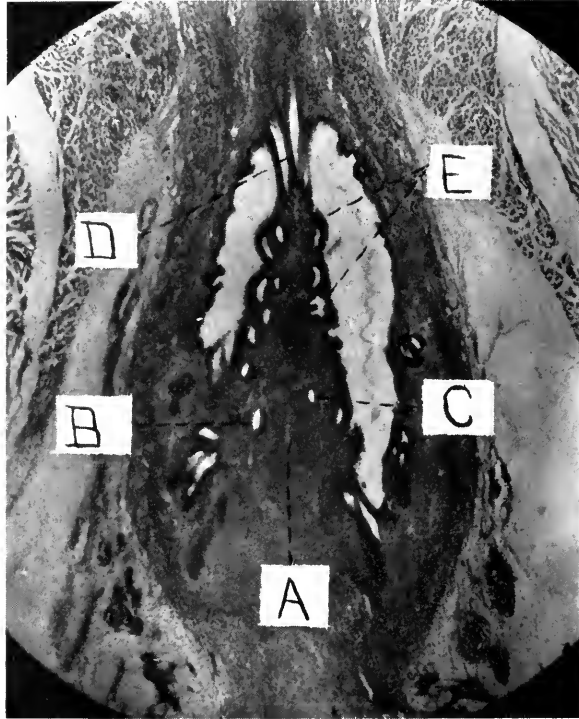


FIG. 4. CROSS SECTION THROUGH VERUMONTANUM. FETUS FOURTEEN WEEKS OLD

*A*, prostatic utricle; *B*, left ejaculatory duct; *C*, right ejaculatory duct; *D*, anomalous attachment of the veru to the roof of the urethra (three inferior striae—denuded of mucous membrane); *E*, peripheral gland tubules of mucous membrane origin.

by the poor staining qualities of the epithelium and later by its fragmentation. With this superficial cellular destruction the basement membrane also becomes broken through, leaving the stroma and intertubular structures denuded of all its protecting surface. Continued pressure with the approximation

of the intertubular stroma of the colliculus to the submucous layers along the roof of the urethra, together with the active process of growth at this time causes a firm attachment of the tip of the colliculus and the inferior striae to the roof of the urethra. Following this picture, it is seen that the mucosa

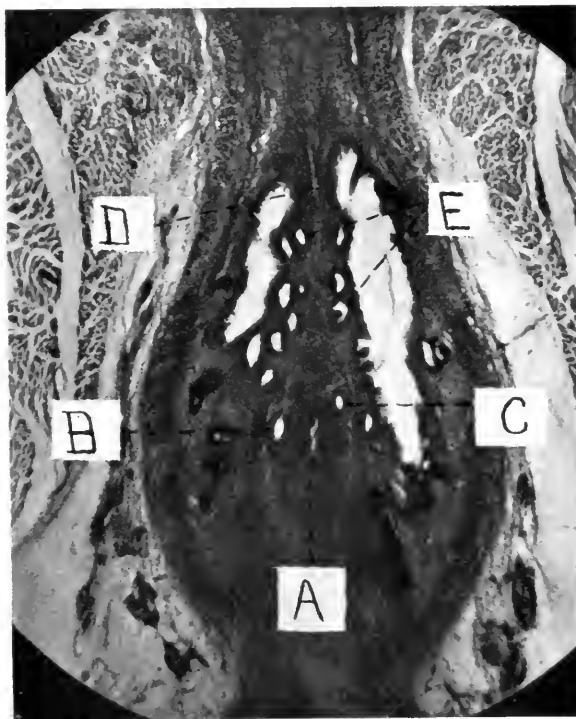


FIG. 5. CROSS SECTION THROUGH VERUMONTANUM. FETUS FOURTEEN WEEKS OLD

A, prostatic utricle; B, left ejaculatory duct; C, right ejaculatory duct; D, firm attachment of veru to the roof of the urethra (structure now covered with mucous membrane); E, peripheral gland tubules of mucous membrane origin.

covering the colliculus becomes continuous with that lining the roof of the urethra. The result is a firm attachment through continued growth of the lower portion of the verumontanum to the roof of the urethra. This condition has been found in fetuses at the fourteenth week of fetal life, at which time there were no evidences in the specimens studied of the usual sec-

ondary changes, i.e., dilated, trabeculated bladder, dilated ureters and associated hydronephrosis.

The presence of these bands in the posterior urethra at this early time of intra-uterine life may readily inaugurate the beginning of the early secondary changes which are usually found

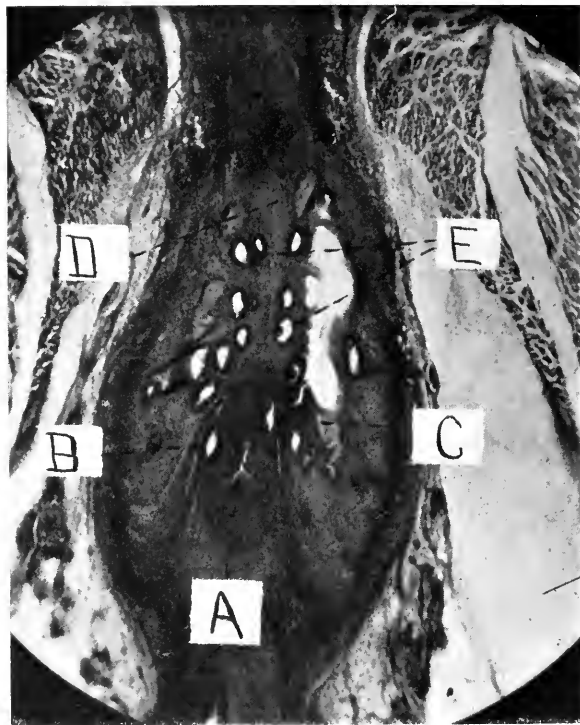


FIG. 6. CROSS SECTION THROUGH VERUMONTANUM SHOWING COMPLETE OCCLUSION OF THE URETHRA ON THE LEFT SIDE, AND A GREATLY NARROWED LUMEN ON THE RIGHT SIDE

A, prostatic utricle; B, left ejaculatory duct; C, right ejaculatory duct; D, firm verual attachment now continuous with the urethral roof; E, gland tubules of mucous membrane origin.

soon after birth in certain cases—while in others the continued effort in urination over a few years undoubtedly brings about the more marked pathology of the middle and upper urinary tract.

That a somewhat similar sequence of events may occur along the lower urinary tract has been demonstrated in the study of the etiology of certain vesical diverticula (19) in which instances the factors of increased and irregular intra-abdominal and intra-pelvic pressure augmented by pressure necrosis of

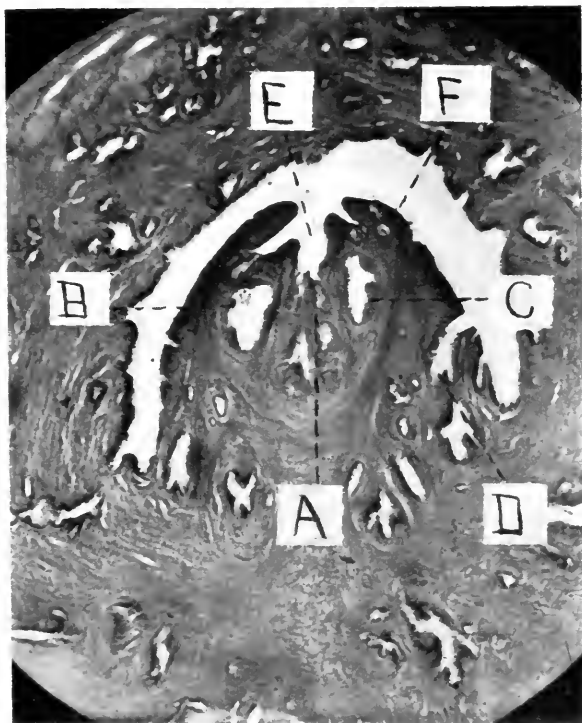


FIG. 7. CROSS SECTION THROUGH NORMAL VERUMONTANUM AT BIRTH

A, gland tubules of utricular origin; B, left ejaculatory duct; C, right ejaculatory duct; D, gland tubules of prostatic origin; E, prostatic utricle opening into urethra; F, gland tubules of mucous membrane origin.

approximating mucosa covering certain folds within the bladder seem of a very definite significance.

#### DISCUSSION

From the material and evidence at hand it can be stated that the so called valves or congenital strictures of the prostatic

urethra may have their origin as early as the fourteenth week of fetal life, at which time there were present in the specimens studied no associated secondary sequellae such as the dilated posterior urethra, dilated trabeculated bladder with hydroureters and hydronephrosis as is usually found in the latter pictures of this condition. The valve formation is due to the growth and attachment of the tip of the colliculus to the roof of the urethra and occurs at the time of marked epithelial activity of this and associated parts, namely, the invagination of the veru mucosa to form the first observed tubules of the verumontanum, and of passing interest it may be stated that it occurs also at the time the diverticula of the seminal vesicles are first noted (20). The view of Wilckens that these folds are remnants of the cloacal membrane which are left when the cloaca divides into the sinus urogenitalis, perineum and rectum cannot be sustained, for at the time this anomaly occurs the above structures are all clearly defined. Also Posner's contention that these folds are the result of faulty union of the pars prostatica and pars membranosa of the urethra seems hardly to be supported. Lowsley's statement seems more nearly correct, that they may be anomalies of the Wolffian and Müllerian ducts, but even this is not entirely adequate. The study of the reported specimens would seem to indicate that these obstructing valves have their origin in the anomalous attachment of the lower portion of the colliculus seminalis and inferior striae to the roof of the urethra.

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## BONE METASTASIS FROM PRIMARY CARCINOMA OF THE URINARY BLADDER

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Kretschmer (1) has recently called attention to the fact that carcinoma of the urinary bladder, contrary to the prevailing view, not infrequently gives rise to bone metastasis, which may be extensive even when the bladder tumor is small. He reported five such cases, two observed only clinically in which the bone metastases were demonstrated roentgenologically and three studied at autopsy. The distribution of the metastases in the three autopsied cases were as follows: In case 2, in the glands in the perivesical fat, and in the bony pelvis; in case 4, in the bony pelvis, right eighth rib, left second and ninth ribs, in the mesenteric, retro-peritoneal, inguinal, and tracheo-bronchial glands, and in the liver; in case 5, in the eighth rib and in the liver. Autopsies were not performed in two cases and the metastases as determined by the X-rays were as follows: In case 1, in the bony pelvis; in case 3, in the spine. In all cases the bone metastases were of the osteo-clastic type. The histological character of the growth was stated to be that of a papillary carcinoma in two of the cases but the other three were not described.

As several clinicians have pointed out, it is of importance to appreciate that bladder carcinomas occasionally do produce bone metastasis, since this fact makes it necessary to establish by rentgenography the absence of such metastases before subjecting the patient to serious operative treatment. Most of the texts, and many of the articles on cancer of the bladder fail entirely to mention this possibility. Thus, Schoel (2) in his recent discussion of bladder tumors, makes no mention of bone metastases.

It requires not a little search through the literature to find any discussion whatever of the occurrence of bone metastasis from bladder carcinoma, yet the fact that Kretschmer has observed five such cases within a relatively brief time indicates that such occurrences are probably much less infrequent than has been believed. It has therefore seemed worth while to go into the literature on this subject with some care,<sup>1</sup> in order to bring out the exact status of the subject at this date. Wolff (3) makes the following statement:

According to almost all observers carcinomas of the urinary bladder have only a slight inclination to metastasis formation because the urinary bladder has no lymphatics. Therefore generalization can only take place by way of blood vessels, a circumstance which explains the relatively frequent secondary involvement of the osseous system. Even the older observers, as, for example, Schraut in 1854, described such cases, and newer observers, as, for example, Goldmann, have demonstrated that bone metastases can occur from urinary bladder cancers only by way of the veins. Often the primary tumor of the bladder is very small and may cause almost no symptoms while the bone metastases appear as the first manifestation and dominate the clinical picture.

Concerning metastasis from bladder tumors Posner (4) states that remote metastases (excluding growths in contiguous structures) occurred in but twelve of one hundred and seventeen cases of carcinoma of the urinary bladder. Therefore he accepts as a fact the infrequency of metastases from bladder tumors, but states that Albarran has disproved the statement that the bladder lacks lymphatics.

Ewing, in his *Neoplastic Diseases* (1st ed., p. 841) says of papillary carcinoma of the bladder that

Extensions occur through the wall of the bladder to the pelvic tissues, up the ureters toward the kidneys, along the pelvic lymphatics to the vertebral lymph-nodes. Rarely there is a superficial extension of a papillary carcinoma of the urethra into the bladder (Fluss, Lit.), or vice versa (Adenot). Metastases are not common but have been

<sup>1</sup> In this I have had help from Mr. G. H. Zwick.

observed in liver, lung, pleura, kidney and inguinal and axillary lymph nodes. Albarran saw a pulmonary metastasis two years after removal of a solitary papilloma, the bladder remaining free. He accepts frequent propagation by contact but does not insist on the actual implantation of tumor-cells. The bulky widespread metastases of prostatic cancer are regularly wanting.

Kretschmer reports that Moore (5), in a study of 65 cases of metastatic growths in bone, had none primary in the bladder, and cites single cases reported by Woodruff (6) and by Westerkamp (7). To these reports we can add the following instances:

Kastner (8) in 1908 reported the case of a man aged sixty-nine, with a "medullary" carcinoma of the fundus of the bladder, producing metastases in the marrow of both femurs, left tibia, the first and second lumbar vertebrae, both adrenals, thyroid, liver and retro-peritoneal lymph glands. The primary tumor is described as "handtellergröss," fungoid with a broad base; microscopically composed of alveoli filled with undifferentiated epithelial cells, located chiefly in the mucosa with little infiltration of the muscularis. Kastner says that in the literature available to him he found no case of bone metastasis from primary bladder cancer. He quotes Schramm as reporting sixty-five cases of bladder cancer, of which twenty produced metastases but none in the bones. Hess found in 8162 autopsies at Munich, ninety-seven cases of bladder cancer, but apparently observed no bone metastases since Kastner does not speak of any in this material.

Geissler (9) reported a case of tumor "as large as a fist" in the left scapula in a man forty-two years of age, which was removed by operation and found to have an alveolar, carcinomatous structure. Although urinary symptoms called attention to the bladder, cystoscopic examination did not disclose any tumor. Several months later, however, a cancer of the bladder was removed with the same structure as the bone growth. No autopsy was performed.

Williams (10) says that in his six autopsies for cancer of the bladder he had only one metastatic growth, a nodule in the liver, but he mentions that S. Cooper has observed cancer of the bladder to disseminate to the left femur and the right fifth rib.

More recent literature indicates that bone metastasis is much less rare than the above figures indicate, which is undoubtedly in large part due to the fact that the Roentgen ray often discloses them in the clinic, when they might be overlooked at autopsy since they do not always produce noticeable bone enlargement or fracture. These recent observations, however, have generally appeared as casual statements rather than as specific reports of cases, but a few of them may be mentioned.

In discussing a paper by Judd and Sistrunk (11) on cancer of the bladder, Hyman speaks of the necessity of roentgenographic examination of the spinal column before beginning treatment of these cases, but mentions no observations on such metastases.

Chute (12) reports twenty-nine cases of bladder cancer with eighteen operated, all but one of which showed recurrence within three years, but he does not state whether bone metastases were present in any of his cases.

Morton (13) says that malignant tumors of the bladder kill through metastasis to the lungs, bones or abdominal glands but gives no evidence in support of this statement.

E. Fuller, in discussing a paper by Squier (14) reports a case in which five weeks after partial resection of the bladder for cancer the patient suffered a fracture of the upper third of the thigh from metastasis. Lower has also reported a case in which operation was performed but the patient had metastases in the bones.

Alice Hamilton (15), in discussing bladder cancer in dye workers, says "the cancerous growth may invade the neighboring lymph glands or the ureter and kidney, as in one of Rehn's cases, or the bones of the pelvis and the lower abdominal wall as in a case seen by Czerny (16). Only one autopsied case has shown metastases in liver and lungs."

Nevertheless, Nassauer (17) in his report on thirty-eight cases of cancer of the bladder in dye workers, makes no mention of bone metastasis, although there is no indication that roentgenographic examination of the bones was made in any of these cases. But five were autopsied, one showing metastasis in the pelvic glands and one a few small nodules in the liver.

In five cases of carcinoma of the bladder that I have autopsied, none has shown any metastasis whatever.

It is interesting to observe that the twenty authentic cases of primary carcinoma of the ureter collected by E. C. Schmitt (18) showed nearly always more or less metastasis, chiefly into the regional lymph glands, the lung and liver. In two cases the peri-ureteral extension reached the pelvic bones leading to a clinical diagnosis of sarcoma of the pelvis, and in another case, that reported by Adler (19), metastasis into the fourth lumbar vertebra completely destroyed its body, the spinal symptoms having dominated the clinical picture. In my own case, reported by Schmitt, direct extension to the bodies of the vertebrae from the eleventh dorsal to third lumbar had taken place, with almost complete destruction of the third.

In forty-three cases of primary non-papillary carcinoma of the renal pelvis reviewed by Kretschmer (20), osseous metastases were described in five.

As to sarcoma of the bladder, we find no statement concerning metastasis to bones beyond that contained in Legueu's "*Traite Chirurgial d' Urologie*" (1910, p. 869) that extension is mostly to the bones, although metastasis is mostly to the lungs, liver and spleen. Munwes (21) analyzed the literature to 1910, finding reports of one hundred and seven cases, but makes no mention of osseous metastasis. In forty-six recorded autopsies, metastases were found in twenty-four, none being in the bones.

Having had occasion to study at autopsy a case in which a comparatively small carcinoma of the urinary bladder gave rise to a remarkably large secondary tumor of bone, it seems desirable to add this case to the scanty literature on bone metastasis from cancer of the bladder. The patient, a laborer sixty-eight years old, was brought to the Cook County Hospital on February 10, 1921, suffering from the effects of a huge tumor mass involving the sternum. He said that he had first noticed the growth two months before, at which time it was a small lump, sometimes causing pain but not constantly. Except for the occurrence of pain in the lower dorsal region during the

period between ten and five years ago there was no history of any previous illness. Especially is to be noted the absence of any mention of symptoms referable to the bladder, although while he was in the hospital there was frequency of urination. The urine was reported as containing albumen but no casts or cells, although alkaline in reaction. It was recorded that the protein was not of the Bence-Jones type. Examination revealed no physical changes of importance except for a great symmetrical rounded swelling on the anterior chest wall, hard, not pulsating and without murmurs. The lungs and heart showed no noteworthy abnormalities, beyond pulmonary emphysema. There was a bilateral hydrocele. A specimen of blood was examined by the Abderhalden method by Dr. Julius Retinger, who reported a positive reaction with carcinoma substrate.

After the patient was in the hospital a few days he became delirious, gradually grew weaker, dyspnea developed and he died February 22, the body being examined twenty-four hours later. The chief autopsy findings follow:

*External appearance.*—Body of a poorly nourished white man about sixty-five years of age. The skin is pale and the sclera white. Nothing abnormal in the mouth, few and poor teeth. The left axilla contains an enlarged lymph gland about 2 cm. in diameter. There is no edema of the feet. There is a protrusion over the chest in the midline from the second rib to the xiphoid. It is elastic upon palpation and the skin over it is freely movable but the tumor itself is immovable. The outline of the tumor is irregularly circular, measuring 12 cm. transversely and protruding 4 to 5 cm. from the level of the chest wall. The skin covering the tumor is not discolored or altered. There is a firm mass 3 cm. in diameter attached to the first right costal cartilage and seemingly not connected with the large tumor mass. There is a superficial scar over the third interspace in the mid-clavicular line. The scrotum is greatly distended by two symmetrical swellings, the right being slightly larger, which fluctuate; both are about 8 cm. long and 5 cm. in diameter. There are no external marks upon the back. There is about 1 cm. of subcutaneous fat in the midline. Right axillary glands are not enlarged; subcutaneous tissue about the right axilla is edematous.

*Abdominal cavity* shows no important changes.



*Pleural cavities.*—The left pleural cavity is completely obliterated anteriorly and posteriorly contains about 200 cc. of bloody fluid.

The right pleural cavity is entirely obliterated by adhesions.

*Pericardial cavity* has a smooth surface and contains only the normal amount of fluid. The pericardium is freely movable under the sternal tumor mass, there being no infiltration or nodules in it.

*Mouth, tongue and pharynx* are all normal.

*Larynx* is small but the tracheal mucosa is hyperemic; the cartilages are calcified and there is a slight lateral compression of the trachea.

*Oesophagus* is normal.

*Thyroid* contains a colloidal cyst about 15 mm. in diameter replacing the right lobe; otherwise it is small and poor in colloid and its weight is 15 grams.

No remains of the *thymus*.

*Heart* weighs 320 grams. The myocardium shows no gross changes. The wall of the left ventricle is 12 to 14 mm. thick and the right 2 to 4 mm. thick. There is a diffuse hemorrhage in the endocardium of the left ventricle. The valves are normal and the foramen ovale is closed. The beginning aorta is free from sclerosis but the thoracic portion contains numerous small sclerotic patches in the descending portion, increasing in the abdominal aorta with calcification near the bifurcation. The carotids are sclerosed. The cerebral arteries are much calcified. Each internal carotid artery immediately after entering the skull dilates to 1 cm. in diameter, being practically aneurismal, nearly filling the sella turcica, but without erosion of the bone.

*Lungs.*—The left is somewhat boggy and weighs 600 grams and upon palpation the lower parts are heavy and inelastic and contain a small amount of fluid. Bronchi everywhere have stiff walls and some are calcified.

The right lung weighs 1040 grams and upon palpation the lower lobe is semi-solid throughout but the pleura over it is smooth and contains no consolidations. Cut surface of the lower lobe of right lung shows distinct small gray areas of consolidation and little fluid. The posterior portion of the middle lobe is similar. A tumor mass 3 cm. in diameter, pink and soft, is found in the upper lobe.

*Peribronchial lymph glands* and also the tracheal are anthracotic but show no tumor nodules and no gross tuberculosis. All the lymph glands of the anterior mediastinum are similar but the anterior mediastinal space is obliterated by the sternal tumor mass.

*Liver* margin is two fingers above the costal margin and the gall bladder is adherent to the transverse meso-colon. The gall bladder is, however, normal in size and contains no concretions. The liver is small, weighing 1350 grams, and presents at the notch of the round ligament two tumor nodules each 2 cm. in diameter. On the anterior surface there is one 5 cm. in diameter and a somewhat smaller one on the posterior surface. The cut surface shows no gross changes and no tumor nodules within the organ. The cut surface of the nodules is white.

*Spleen* is of normal size, weighs 160 grams, and shows many fibrotic areas in the capsule. The cut surface is normal except for thickened vessels.

*Pancreas* is small and atrophic but shows no gross changes.

*Stomach* wall is thin and displays less than normal folding of mucosa. About 8 cm. above the pyloric ring near an area of hyperemia is a puckered stellate scar almost 10 mm. in diameter, in the lesser curvature.

*Intestines* are normal.

*Kidneys*.—Left shows a pale cortex 2 to 3 mm. thick with the markings well preserved. The capsule strips easily, leaving a smooth surface. Right contains at the lower pole a white nodule  $1\frac{1}{2}$  mm. in diameter.

Weight of the kidneys together is 200 grams.

*Urinary bladder* is thick walled and the internal surface is covered with a bloody purulent material while an irregularly spherical mass projects from the center of the posterior surface, about 35 mm. in diameter and having a slightly ulcerated surface. A considerable quantity of inorganic salts is deposited on the surface of the mucosa, which shows seven pedunculated nodules from 2 to 10 mm. in diameter about the central mass. Main tumor is pedunculated, its base being 2 cm. in diameter. There are numerous submucous hemorrhages.

*Generative organs*.—The prostate is small and hard and contains many corpora amylacea but no tumor growths. There is no infiltration of the tissues about the bladder.

Seminal vesicles are small and empty.

Testicles are surrounded by mass of fluid and each weighs with this fluid 200 grams. The fluid is clear and serous in character. The testicles themselves appear normal.

*Lymph glands*.—The right axillary lymph glands are not enlarged but reddened. The left axilla contains one enlarged to  $2\frac{1}{2}$  cm. in diameter whose cut surface shows uniform white tissue. Mesenteric lymph glands are not enlarged, neither are the retroperitoneal glands. Tonsils are atrophic.

*Meninges* are smooth and normal. Brain weighs 1300 gms. The cortical convolutions are slightly atrophied. The cerebellum and mid-brain show no gross changes; neither do the cerebral hemispheres and lateral ventricles. The hypophysis is compressed between the aneurisms of the internal carotids into a disc 12 mm. in diameter and  $1\frac{1}{2}$  mm. thick, weighing 0.3 gms.

*Spinal cord* is apparently normal.

*Muscular system* is normal.

*Skeleton*.—The costal cartilages are calcified and the costal margins flare so that the antero-posterior diameter of the chest is increased. The tumor is symmetrical with the body of the sternum as a center; it protrudes about 5 cm. each anteriorly and posteriorly. The retro-sternal mass is slightly smaller than the pre-sternal in each dimension. The tumor possesses a distinct capsule and contains many distended vessels. On the posterior surface a prolongation 2-3 mm. thick passes up from main mass to the supra-sternal notch and laterally corresponds to the borders of the sternum. The sternum has disappeared completely. The growth spreads out over the right first rib for about 2 cm. and protrudes anteriorly about 2 cm. When dissected free the greatest transverse diameter anteriorly of the tumor is 12 cm. which is at the fifth interspace. At the third rib it measures  $7\frac{1}{2}$  cm. transversely and at the first rib 11 cm. The mass on the posterior surface measures 10 cm. at the fifth rib. It is 23 cm. long, extending from upper border of sternum to xiphoid appendix of sternum. The tumor is slightly nodular and irregular in consistence, feeling similar to a normal kidney. It can be cut in two anteriorly in the midline with ease, the knife encountering no bony structures except for an egg shell cast of the upper border of the manubrium. The tumor is in general composed of whitish tissue with numerous extensive hemorrhagic areas and occasional yellow necrotic spots. The growth is distinctly radiating in character. The entire mass, including the costal cartilages, weighs 1640 grams.

The fourth right rib has a soft, bloody tumor mass on its anterior aspect extending for 5 cm. from the vertebra and 4 cm. in diameter, protruding into the pleural cavity. The left first rib has a nodule 6 cm. long and 4 cm. in diameter extending from the chondral junction to about 3 cm. from the spinal column. The left fifth rib has a nodule 5 cm. long and 2 cm. in diameter. The other ribs, dorsal and cervical vertebrae are not affected.

The vertebrae show numerous exostoses but no tumors.

Right ilium near the crest has a sub-peritoneal tumor nodule about 6 cm. in diameter and similar in character to the others.

Pelvic bones otherwise have no palpable nodules.

Calvarium is thick but skull shows no nodules.

No nodules palpable in long bones.

*Anatomical diagnosis.*—Primary ulcerating papillary carcinoma of urinary bladder with metastases in vesical mucosa. Secondary papillary carcinoma of sternum. Carcinoma metastases in left axillary lymph glands, left lung, right kidney and liver; also in right first and fourth and left first and fifth ribs and right ilium. Acute cystitis. Bilateral adhesive pleuritis. Left hydrothorax. Bilateral hypostatic pulmonary congestion. Confluent hypostatic bronchopneumonia of right lower and middle lobes. Healed gastric ulcer. Marked senile arteriosclerosis with atheroma of the vessels. Healed ulcers of the left leg. Bilateral hydrocele. Calcification of tracheal and bronchial cartilages. Slight hypertrophy of left cardiac ventricle with diffuse sub-endocardial hemorrhages. Cyst in the thyroid. Senile atrophy of viscera. Aneurysmal dilatation of both internal carotid arteries within the skull with pressure atrophy of the hypophysis.

#### HISTOLOGICAL REPORT

*Tumor.*—The primary growth presents all the usual features of papillary epidermoid carcinoma of the urinary bladder (fig. 1). The growth is composed chiefly of flat, spindle-shaped epithelial cells, packed closely together, forming layers from five to twenty cells deep supported by a delicate stroma of connective tissue which is rich in blood vessels. The epithelial cells when much flattened have compact nuclei filled solidly with fine deeply-staining chromatin granules; when less compressed the nuclei tend to assume a vesicular character with distinct nucleoli and a moderate amount of homogenous cytoplasm. Numerous mitotic figures testify to the malignancy of the growth. Special connective-tissue stains show that the fibrous tissue is limited to the central core. The papillae are packed closely together although occasionally they are separated by a little mucus. Despite the macroscopic evidences of acute cystitis there is practically no infiltration of the tumor growth by leucocytes. There is no hemorrhage, necrosis, or other retrogressive change.

The secondary tumors in the bone all show a structure similar to that of the primary growth, consisting of masses of flattened epithelial cells, supported by a delicate central stroma of connective tissue (fig. 2).

Because of the absence of free space the epithelial layers are generally in contact with one another, so that the growth resembles more closely an alveolar than a papillary structure; occasionally however, there is enough hemorrhage or disintegrated material between the epithelial layers to show the true papillary character of the growth. Very little of the original bone material remains in the form of small eroded spicules. Special stains show that there is a very little fibrous tissue stroma lim-

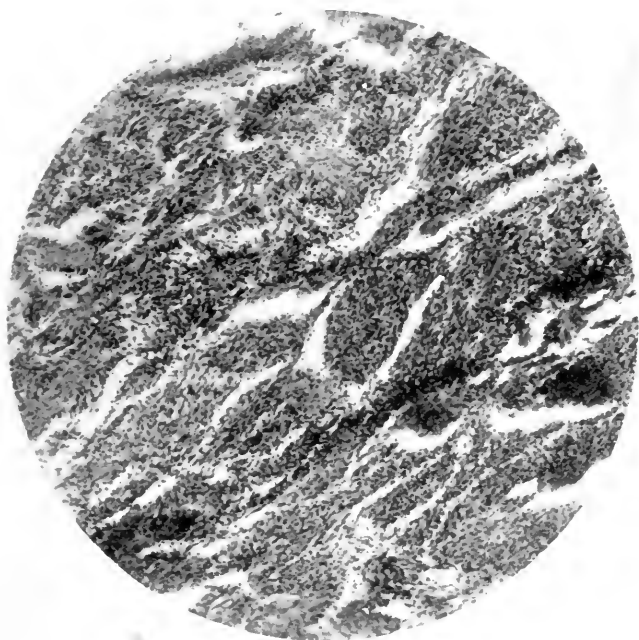


FIG. 1. PRIMARY PAPILLARY CARCINOMA OF THE URINARY BLADDER.  $\times 60$ .  
THE PAPILLARY ELEMENTS ARE CROWDED CLOSELY TOGETHER,  
RESEMBLING A SOLID GROWTH.

ited to the central vascular cord with no fibrous elements between the tumor cells themselves. Mitotic figures are also numerous in the secondary growths, and although there is considerable hemorrhage other retrogressive processes are lacking.

*Kidneys.*—These show a small proportion of the glomeruli to be wholly or partially fibrotic, but this change is not extensive and there is no interstitial increase and little atrophy of the tubular elements.

There are a few calcified deposits within the tubules, and occasional hyaline casts. The arteries are much thickened. On the whole the kidney shows little if any more change than is usual in subjects of this age. There is one small nodule of tumor tissue.

*Thyroid* contains an adenomatous nodule enclosed in a dense fibrous capsule; outside this the gland is almost devoid of colloid.

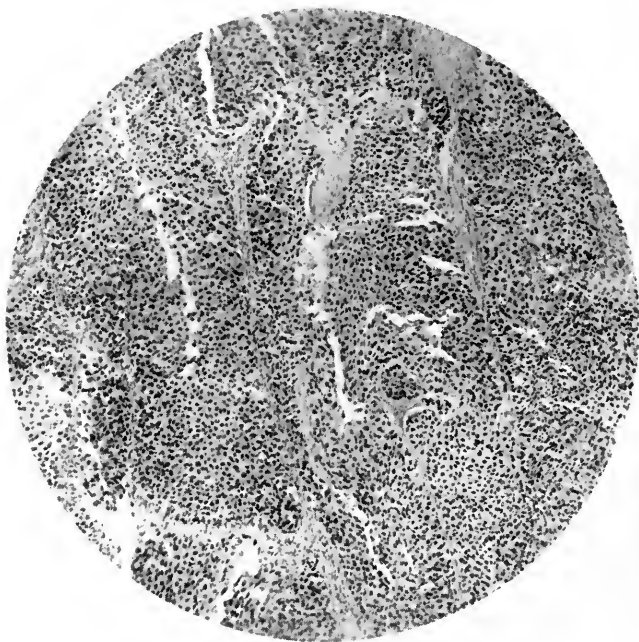


FIG. 2. SECONDARY PAPILLARY CARCINOMA OF THE STERNUM.  $\times 60$ . THE CROWDING OF THE STRUCTURE HERE PRODUCES A RESEMBLANCE TO AN ALVEOLAR CARCINOMA.

*Pancreas* shows some patches of fibrosis about the ducts with a slight general atrophy and replacement by fatty areolar tissue but the islands of Langerhans are apparently normal.

*Stomach*.—Mucosa in general is distinctly atrophic with an increased amount of interstitial tissue and round cells between the glands; the site of the ulcer scar shows no evidence of active inflammatory processes.

*Hypophysis* is greatly distorted by pressure. The anterior lobe is flattened out to about 1.5 mm. thickness and the cords of epithelial

cells lie parallel to the surface, being atrophied and apparently with decreased numbers of cells. There are no evidences of necrosis or other degenerative processes and the pars intermedia contains a little colloid.

*Lungs* show typical confluent bronchopneumonic foci. No tumor cell emboli can be found here or in any other organs.

*Spleen*.—No noteworthy changes.

*Heart*.—Myocardium seems to be normal except for sub-endocardial hemorrhages.

*Carotid arteries*.—These are greatly dilated and a thick layer of calcification has almost entirely replaced the media. There are no evidences of syphilis.

#### RECAPITULATION

A man with a typical papillomatous tumor of the urinary bladder which had caused no symptoms of which he complained, developed an enormous secondary growth in the sternum which was completely replaced by tumor tissue. This growth was so large, weighing about the same as a normal human liver, and so symmetrically disposed as to the sternum, that at the autopsy it was believed to be a primary sarcoma of the sternum, the bladder tumor being thought to be merely a coincidental matter. Microscopic study, however, showed the tumor of the bone to be derived from the papillary carcinoma of the bladder, as also were the metastatic growths in the ilium, in four ribs, the lung, the kidney and the liver. We can find no record of any other case of bladder carcinoma with a comparable amount of bone metastasis.

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## A PROCEDURE FOR THE CURE OF PROSTATIC ABSCESS

B. S. BARRINGER

The following procedure has been used to cure fifteen consecutive cases of prostatic abscess — cases which otherwise would have been operated upon by the radical method.— The patient is put in the lithotomy position, the perineum prepared as for operation, no general anesthesia is given. With the gloved index finger of the left hand in the rectum the perineum is anesthetized with  $\frac{1}{2}$  of 1 per cent novocain and adrenalin, using for this purpose a  $3\frac{1}{2}$  inch, 18 gauge needle. The anesthetic is injected ahead of the needle. The needle enters between the urethra and rectum, and the point of the needle palpated just in front of the prostate by the rectal finger. This is important because upon it depends the accuracy with which the needle is plunged into the different lobes of the prostate or seminal vesicles. From this point the needle is thrust forward into the lobe of the prostate in which the abscess is thought to be. A 5 cc. syringe is attached to the needle and suction applied. If pus is found it is aspirated, the needle being gently pushed back and forward and the point rotated so that all of the pus may be aspirated from the abscess cavity. Each lobe of the prostate is punctured and if there is any suggestion of supraprostatic abscess or abscesses of the seminal vesicles these are likewise punctured and aspirated, the guiding finger in the rectum always indicating the way for the needle. A needle of the lumbar puncture type with not too acute a point is the best for the operation. Naturally the same needle is used for the anesthetization as for aspirating the pus, no withdrawal of the needle being necessary.

The origin of the procedure was as follows:

During the anesthetization of a cancerous prostate for the introduction of radium needles a peri-prostatic abscess secondary

to a carcinoma of the prostate was found and as it was thought unwise to operate upon such a case, an ounce or more of pus was aspirated and the patient left to see if this would not relieve him. It did perfectly, and there was no recurrence of pus. With this experience in mind, it was thought that the method might be applied to prostatic abscesses secondary to gonorrhea, and in this way it might be possible to evade the more serious and accepted operation. If the procedure did not work in any case the patient would be in the hospital, and a perineal section for drainage of the abscess could be done. There apparently was no great risk in trying the method out. So far no untoward results have occurred. All of the cases have been relieved without operation. While it seems a non-surgical procedure it has worked in these fifteen consecutive cases. The details of these cases are as follows:

*Etiology.* Twelve of the fifteen cases were gonorrheal in origin, one carcinomatous, one subsequently proved to be tuberculosis of the prostate; and one a cyst of the prostate.

*Retention of urine.* Data on eleven of the cases: No. 1, incomplete retention for two weeks, several times complete retention and catheterization. No. 2., no retention. No. 3, retention two days complete. No. 4, no retention. No. 5, incomplete retention for four days, then complete retention and catheterization. No. 6, complete retention for one day and catheterization. No. 7, incomplete retention for eight days. No. 8, incomplete retention for five days, then complete retention three days with catheterization. No. 9, incomplete retention two days. No. 10, no retention. No. 11, retention for one week and catheterization. Chills and fever. But two of the cases had chills and fever.

*Abscess, pre-operative.* All of the cases were thought to have an abscess prior to the needle puncture.

*Gonococci in urethral smear.* In ten of these twelve cases typical gonococci were found in the urethral smear.

*Pus found and aspirated at operation.* Complete data on twelve cases. No. 1, no pus. No. 2, few drops of pus. No. 3, pus 16 cc. No. 4, no pus. No. 5, pus, 15 cc. No. 6, pus, 30 cc. No. 7,

30 cc. No. 8, small amount of broken down tissue (this case was a cyst to the prostate). No. 9, from each lobe, 16 cc. of pus, making in all 30 cc. of pus. No. 10, pus, 15 cc. No. 11, pus, 60 cc. at first aspiration, and 30 cc. of pus at second aspiration (this was the only case which had to be aspirated twice). No. 12, pus, 30 cc.

*Postoperative epididymitis.* Two cases were readmitted to the hospital after they had been discharged (after the aspiration of pus) with an epididymitis. Both of these cases had had the urethra instrumented and the prostate massaged, I believe, too roughly, or too early after the operation. One case developed an epididymitis some time after the operation, and in this case no pus was found in the prostate.

*Cultures of pus found at operation.* The data in eleven cases is untrustworthy as the cultures were not carefully made. Smears of the pus from the prostate showed as a rule no bacteria. One or two showed streptococci or staphylococci.

*Frequency of puncture.* Data in fifteen cases.

Fourteen of the cases required but one puncture and aspiration to cure them. One case had to be punctured twice when 30 cc. of pus was aspirated from the vesicle corresponding to the side on which the prostatic abscess was.

*Relief of retention.* Two of the cases had to be catheterized once or twice after the puncture and then urinated without trouble. One case, that which had to be aspirated the second time, had retention for two days after the first operation, then a second aspiration was followed by catheterization once and complete relief of the retention.

*Temperature post-operation.* In several of the cases operated upon there was a sharp rise of temperature,  $104^{\circ}$ , or  $104.02^{\circ}$  on the day after puncture. I believe this was due to imperfect technic and to too rough massage of the prostate by the rectal or guiding finger during the time of puncture. I believe it does not particularly matter how many times the needle is inserted into the various lobes of the prostate, as long as the rectal finger does not press the prostate too roughly.

*Conditions of prostate some months post-operation.* In but three of the cases have I examined the prostate some time after the discharge from the hospital. All of these, still had pus in the prostatic secretion, and one had bloody pus. These all had been instrumented and massaged by private doctors. and one was having rather increased frequency of urination due to, I believe, too severe massage.

*Operation post-puncture.* None of the cases has come to the accepted operation for prostatic abscess after the aspiration of the pus from the prostate.

The histories of eleven of the cases were as follows:

*Case 1.* W. W., admitted to Bellevue Hospital, August 14, 1919, gives a history of urethral gonorrhea for two weeks, and a history of swelling of the left testicle for one week. There was no retention of urine, but the rectal examination revealed what was thought to be a prostatic abscess. Under local anestheasia a needle was introduced into the prostate, but no pus was obtained. Subsequently an epididymectomy for tuberculosis of the epididymis was performed. The patient's convalescence was uneventful.

*Case 2.* H. T., admitted to Bellevue Hospital, August 15, 1919, with a history of gonorrhea for one month. Three days ago frequent urination, having to void every fifteen minutes, and complete retention two days ago. Has been catheterized frequently. Has had pain in the lower abdomen, and in rectum and a urethral discharge. Rectal examination revealed a prostate very tender, much larger than normal and fluctuating. Temperature was normal. Under local anesthesia, 30 cc. of pus was obtained from the prostate. The first day after operation the temperature rose to 104, the second day dropped and the third day was normal. The postoperative care was hot rectal irrigations. Not able to urinate day after the operation, but after one day of catheterization was able to urinate.

*Case 3.* Admitted to Bellevue Hospital, August 16, 1919. Fifteen days before admission became constipated and had discomfort in rectum, and scanty and frequent urination. Some soreness in the perineum. The right testicle was enlarged, of normal consistency. There was no hydrocele. Cord not thickened. Pain in perineum and deep urethra. Rectal examination revealed the prostate enlarged and tender with a large fluctuating mass in the center. Temperature

102.4°. The operation, under local anesthesia, revealed the prostate the site of a large abscess which was punctured with a needle, and 16 cc. of pus removed. The day after operation the temperature rose to 104.2° and the third day dropped to normal, and remained so. He urinated without any difficulty after the operation.

*Case 4.* J. D., admitted to Bellevue Hospital, August 16, 1919. First attack of urethral gonorrhea, August 4, 1919. August 9, the left testicle began to swell and become painful. The left epididymis was enlarged, and tender and the prostate thought to be the site of an abscess. With a needle two drops of pus were removed from the prostate. Subsequently his epididymis was operated upon. The recovery was uneventful.

*Case 5.* J. A., admitted to Bellevue Hospital, August 17, 1919. Three weeks previous, gonorrhea. Four or five days ago, pain on urination, and dysuria, the patient having to void about every half hour. Two days previous to admission, had to be catheterized, and now he can void with effort and with a great deal of pain in lower abdomen and rectum. Rectal examination showed a prostate enlarged and fluctuating. Under novocain, 16 cc. of pus was obtained from each lateral lobe of the prostate. The after history of the patient was uneventful, the patient voiding without difficulty. One and one-half months after operation the patient returned from his home to the clinic and his prostate was enlarged with a bloody-pus discharge coming from it. He got up two or three times at night.

*Case 6.* J. L., admitted to Bellevue Hospital, August 24, 1919. Five days previously the patient could not void, and went to Bellevue Clinic for catheterization. Had to be catheterized every day until he entered the hospital on the 24th with an acute retention, 600 cc. of urine being removed at that time. He had what appeared to be on rectal examination a cyst of the prostate. A needle was introduced into this and a few cubic centimeters of what looked to be broken down tumor tissue removed. The patient left the hospital with 5 ounces of residual urine, and is to return for further observation.

*Case 7.* Admitted to Bellevue Hospital, September 22, 1919. Eight days before a sharp pain in epigastrium, and noticed a tumor mass above the symphysis. He had to be catheterized two or three times a day which relieved him, and made the tumor disappear. Yesterday he entered the hospital. The morning of entering the patient passed a considerable amount of urine. Rectal examination revealed a prostate enlarged with possibly a little fluctuation on the right side.

There was a sense of induration all over the postate. With a 18 guage needle, 30 cc. of pus was obtained from this tumor mass, and the supra-prostatic region. Left seminal vesicle punctured bloody fluid withdraw. The temperature before operation was 104 and the second day after operation, normal. He voided after operation without difficulty.

*Case 8.* M. C., admitted to Bellevue Hospital, October 3, 1919. Patient had frequent and burning urination for one week. Two days before he came to the hospital, complete retention. The rectal examination showed a bulging right prostatic lobe which was thought to be the site of an abscess. This was punctured, and 30 cc. of thick pus withdrawn. Left lobe was needled and no pus found. After operation the patient had very little reaction, and could void. He left the hospital on October 8, and was readmitted October 14, with a right epididymitis.

*Case 9.* J. K., admitted to Bellevue Hospital, October 11, 1919. His history was that six days ago he awoke with desire to urinate, but could not. He was catheterized by a private doctor every twenty-four hours for four days. He entered the hospital complaining of the inability to urinate, and a pain across his back. His temperature was 100.

Prostate was large and smooth, firm, slight fluctuation, left seminal vesicle palpable as was also the right.

His bladder extended to within 3 cm. of the umbilicus, 1260 cc. of urine were withdrawn. At operation 18 cc. of thick yellow pus was aspirated from the left lobe of the prostate, and none from the right lobe. The patient voided spontaneously the day following operation, and his recovery was uneventful. The temperature the day after operation was 100° which, in a day or two, fell to normal.

*Case 10.* J. B., admitted to Bellevue Hospital, November 19, 1919. Five weeks ago, urethral gonorrhea and painful urination. Two weeks ago, patient had chills, fever, dull generalized pain and inability to pass urine or feces. Under cathartics both were facilitated. The discharge and burning pain on urination returned along with pain in the rectum. He had 600 cc. of residual urine when entering the hospital, and the rectal examination revealed a prostate much enlarged, firm, tender, no fluctuation. We thought it wise to explore the prostate because of the retention of urine, but no pus was obtained from either lobe by needle. The patient was able to void after needling. On the tenth day, post-operation, the temperature rose because of an epididymitis and after a few days fell to normal.

*Case 11.* M. S. F., 26 years of age, first seen in November, 1919. His history was urethral gonorrhea for six weeks. Eight days after the beginning of the gonorrhea, arthritis of elbow wrist and ankle. This arthritis subsided under injections of mixed proteoses with the exception of arthritis of one ankle. This apparently got better under massage of the prostate, and urethral instrumentation which resulted in retention of urine, and a temperature varying from 100° and 102° for three days before I saw the patient. He then had complete retention of urine, and a large fluctuating left lobe of his prostate. The following day, under novocain anesthesias, I evacuated 60 cc. of pus from the left lobe of his prostate. This did not relieve the patient, he still had to be catheterized and two days following, when I saw him (and after two days of complete obstipation) he was given an enema and I aspirated 30 cc. of blood and pus from the left vesicle. Following that he was able after one catheterization to pass his urine without trouble, and his recovery from then on was uninterrupted. The temperature after the first aspiration was between 100° and 100.5° and fell to normal after the second aspiration.

#### SUMMARY

These fifteen cases have been saved general anesthesia, perineal section, damage to the prostatic urethra and long convalescence by aspirating pus from the prostate by the needle method. Up-to-date no untoward results have followed this method, and no cases have had to be operated upon subsequent to the aspiration.

Subsequent experience has indicated that the method should be restricted to gonococcus infections. Abscesses of the prostate caused by streptococcus, staphylococcus or colon bacilli do not do well after aspiration. The method should not be used when the abscess has broken through the capsule of the prostate and is pointing in the ischio-rectal fossa or has extended toward the seminal vesicles. Here operation is indicated.





## A CASE OF PROSTATIC INFECTION COMPLICATED BY OSTEOMYELITIS\*

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To make the report as concise as possible, I have reduced it to the points that characterize the case.

A sudden onset of acute frequency, urgency and moderate tenesmus in an able-bodied, vigorous-looking man fifty-eight years old, of good habits and more than average good health, without urethritis—past or present.

A history of colitis some years before; a degree of asthenia from weeks of over-work and absence of exercise; recent constipation and a confessed absurdly gross error in diet, the consequences of which furnished a prodromal period of about twenty-four hours.

The ease with which light, digital massage of the prostate expressed free, blood-tinged pus from the meatus on the second and third days of the attack, after which period pus was not obtained, though the left lobe of the prostate became moderately swollen, remained stationary a few days without signs of fluctuation, then resolved.

A temperature that ranged from 101°F. to 102°F.; no chills; some sweating.

Hyper-acid urine; 1.025; many red blood cells and a large number of pus cells with consequent heavy traces of albumen; no casts; a marked indican reaction and faint traces of acetone. The colon bacillus absent; the staphylococcus present.

Gradual, uninterrupted subsidence of the bladder symptoms to normal in two weeks. Clear urine, free from albumen.

No direct treatment of the bladder or urethra. The infection being autogenetic, the possibly aggravating effect of instrumentation was avoided. The treatment was purposely limited to digital massage and rectal irrigations. Colonic irrigations with a 3 per cent anhydrous sodium carbonate solution were added, in deference to the acetonuria. This incidental feature soon became marked, but was quickly controlled.

\* Read at the meeting of the American Association of Genito-Urinary Surgeons, Richmond, Va., May 2 and 3, 1921.

The affected joint was the left elbow. Following a slight traumatism only two days after the first prostatic symptoms, there developed with fair rapidity, a very slightly painful fusiform swelling, lightly mottled with redness over the inner aspect, and tenderness over the condyles.

The roentgenogram, made on the sixth day after the traumatism, showed "a very slight lipping about the tip of the olecranon."

The blood Wassermann was negative, the chemistry, just within the upper normal limit; the leucocytes numbered 16,000; the polymorphonuclears 89 per cent; a culture was not made.

The prostatic symptoms (objective and subjective) ran a brief course as already noted; the clinical course of the complicating elbow joint, however, was typically chronic. Partial immobilization, the salicylates, and baking had little obvious positive effect. Measurable improvement began with the addition of potassium iodide, and enabled the patient to return to his office.

The roentgenogram made at this stage showed a surprisingly extensive lesion of the lower end of the humerus; a general surgeon who saw the patient in consultation at this time, thought radical intervention imperative. An intramuscular injection of bi-chloride, however, was followed so promptly by a diminution of the swelling and tenderness that within 48 hours, he reversed his opinion.

The injection of  $\frac{1}{4}$  grain was continued every other day for one month; less frequently for the second month; then discontinued. The baking was continued a while longer. Exercise of the joint (passive and active) was later encouraged.

The results were followed up by roentgenograms at regular intervals. The areas of rarefaction gradually filled up, and the function of the joint became normal, a slight limitation to extension excepted.

The seemingly direct response to the injection of bichloride is of interest, I believe. The question is, did the bichloride cause the effect, or had the pathological process in the lower end of the humerus run its course and had repair already begun?

A second question is, should the left lobe of the prostate have been incised though no fluctuation had appeared?

On the other hand, I think there can be no question as to the advantage of having withheld all instrumentation of the bladder and urethra.

# PHYSIOLOGICAL AND PHARMACOLOGICAL STUDIES OF THE PROSTATE GLAND

## IV. RESPONSE OF PROSTATIC MUSCLE TO DRUGS

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### INTRODUCTION

The modern anatomist no longer relies entirely on mechanical dissection for the investigation of the finer structure of organs and tissues. Physiological experimentation and the use of chemicals play an important rôle in the laboratory of the advanced histologist. The recent advances in the science of pharmacology moreover have opened up still other methods of experimentation along these lines. It has been found that a large number of pharmacological reagents, or drugs, exhibit a most remarkable selective action on certain anatomical structures such as nerve trunks, nerve terminals, muscle cells, etc. Thus for instance it is well known that nicotine in ordinary doses affects almost exclusively nerve ganglia. Epinephrin is known to stimulate the nerve terminals or myoneural junctions of the true sympathetic as distinguished from the bulbar-sacral-autonomic or parasympathetic nerve elements. On the other hand atropin exhibits a selective action for the parasympathetic nerve terminals only; and such drugs as barium exert their effect by an action on the muscle cell itself without the mediation of any terminal nerve elements.

In the present work the author has undertaken to study the effects of a number of drugs on the prostate gland. The prostate gland, as is well known, in addition to its glandular and connective tissue elements contains also a considerable amount of smooth muscle tissue. Inasmuch as all muscle cells are endowed

with the property of contractility it may be expected a priori that these muscle cells of the prostate when properly studied would respond by contraction or relaxation to drugs as would the muscle cells of other organs. That this is true has been shown by Waddell (1) to whom credit should be given as being the first and the only investigator who has inquired into the effects of drugs on the excised prostate gland. The object of the present investigation was a twofold one: in the first place to inquire into the response of prostatic muscle to drugs with the possible view to therapeutic deductions and in the second place to utilize the results obtained in order to extend our knowledge as to the finer innervation of that gland.

#### METHOD

Fresh prostate glands from various animals were excised and carefully cleaned of fat and adherent tissues. Strips of the prostate were then cut and suspended in warm oxygenated Locke's solution by the well known methods generally employed. One end of the preparation being fixed at the bottom of the chamber, the other, or free end, was attached to a lever recording the contractions on a smoked drum. After properly balancing the preparation and keeping it alive in the warm oxygenated medium it was found to record the tonicity and occasionally the spontaneous rhythmic contractions of the prostatic muscle. The effect of the drugs was studied by introducing solutions of the same with a pipet directly into the medium surrounding the prostatic preparation.

The prostates of the following animals were studied: rat, guinea pig, rabbit, cat, dog, bull and a few specimens of human prostates obtained from the operating room.

#### ACTION OF NICOTINE

This drug is known to have a selective effect on nerve ganglia so that excised tissues containing such ganglia respond by a primary contraction and a secondary relaxation upon treatment with the drug. Experiments made with prostatic strips gave in most cases negative results. Only occasionally a slight relaxation was observed to follow treatments with nicotine.

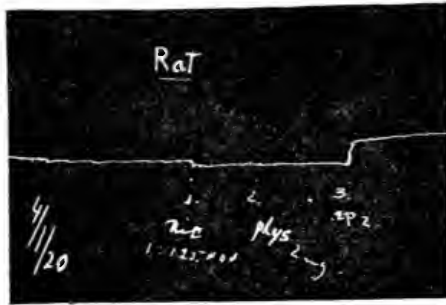


FIG. 1. PROSTATE OF RAT

Nicotine, 1:125,000 produces slight relaxation. Physostigmin, 2 mgm. gives no effect, epinephrin, 2 mgm., produces contraction.

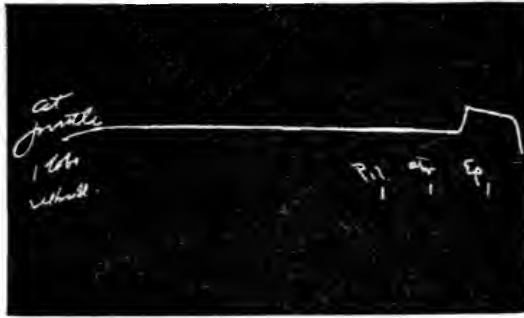


FIG. 2. PROSTATE OF CAT

Pilocarpin hydrochloride, 1 mgm. produces no effect. Atropin sulphate, 1 mgm., no effect. Epinephrin, 1 mgm. gives contraction. Papaverin hydrochloride, 1 mgm. produces relaxation.

#### DRUGS AFFECTING THE TRUE SYMPATHETIC

Two of these were studied. *Epinephrin* was found to produce a rapid and marked contraction of prostate preparations which contractions continued for a long time. Solutions of *ergotoxin phosphate* were also found to produce a powerful contraction of prostatic preparations. The author furthermore studied the effect of one of these drugs on the other. It was found as had been the author's experience with excised surviving arteries that the so called paradoxical reversal of the epinephrin effect was produced by previous treatment with ergotoxin (2). The contrac-

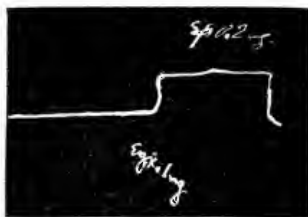


FIG. 3. PROSTATE OF GUINEA-PIG

Ergotoxin phosphate, 0.1 mgm. produces contraction. This causes a reversal of the epinephrin effect (0.2 mgm.).

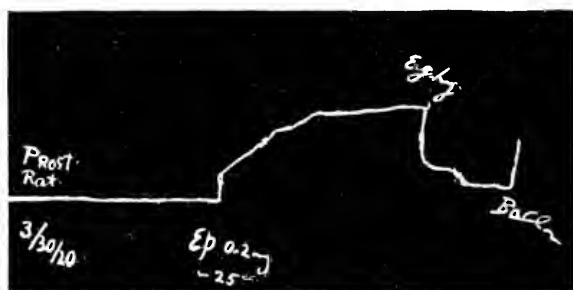


FIG. 4. PROSTATE OF RAT

Epinephrin 0.2 mgm. in 25 cc. Locke produces contractions. Ergotoxin following epinephrin produces relaxation. Barium chloride, 2 mgm. produces contraction.



FIG. 5. PROSTATE OF RAT

Pilocarpin hydrochloride, 2 mgm. gives no effect. Atropin sulphate, 2 mgm gives no effect. Barium chloride, 5 mgm. produces contraction.

tions obtained with epinephrin and ergotoxin separately and the synergistic effect obtained by the use of both of these on the same preparation speak strongly for a true sympathetic innervation of the prostatic gland.

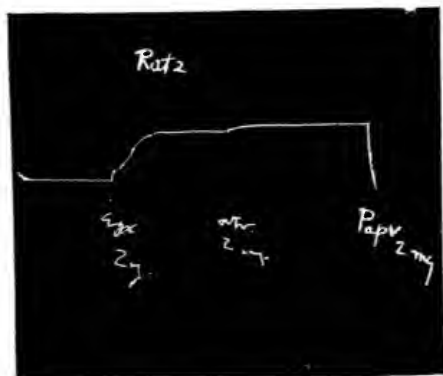


FIG. 6

## FIG. 6. PROSTATE OF RAT

Ergotoxin, 2 mgm. produces contraction. This is not relaxed by addition of atropin sulphate but is antagonized by 2 mgm. papaverin hydrochloride.

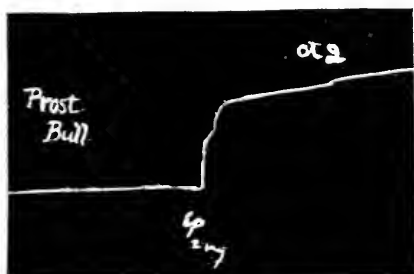


FIG. 7

## FIG. 7. PROSTATE OF BULL

Epinephrin, 2 mgm. produces contraction. Atropin sulphate, 2 mgm., does not relax the contraction.

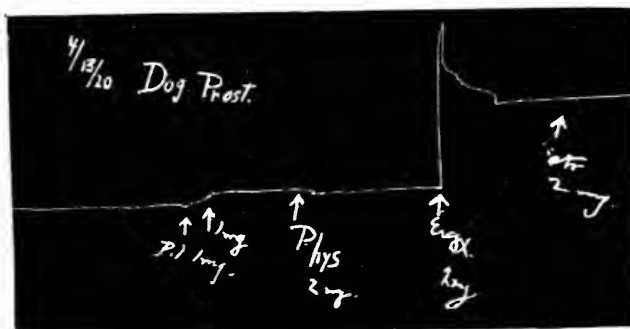


FIG. 8

## FIG. 8. PROSTATE OF DOG

Pilocarpin hydrochloride, 2 mgm. produces slight contraction. Physostigmin hydrochloride, 2 mgm. has no effect. Ergotoxin, 2 mgm. causes powerful contraction. Atropin, 2 mgm. produces no relaxation.

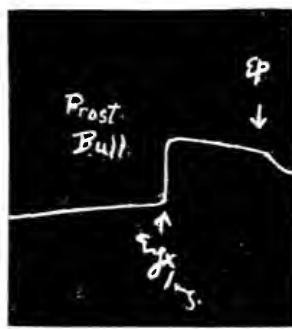


FIG. 9

## FIG. 9. PROSTATE OF BULL

Showing reversal of epinephrin effect following previous treatment with ergotoxin.



FIG. 10. PROSTATE OF RABBIT

Pilocarpin, 2 doses of 1 mgm. each produce slight contraction, which is antagonized by atropin sulphate, 1 mgm.

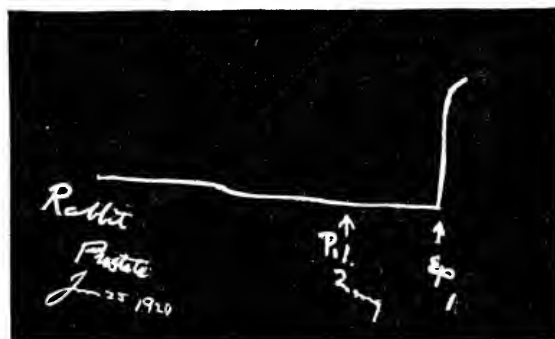


FIG. 11. PROSTATE OF RABBIT

Pilocarpin hydrochloride, 2 mgm. In this case has no effect while epinephrin, 1 mgm. produces a powerful contraction.



FIG. 12. PROSTATE OF MAN, HYPERTROPHIED

Pilocarpin and histamin (B.I.) produce no effect. Ergotxin produces marked contraction.



## EFFECT OF PARASYMPATHETIC DRUGS

A number of drugs belonging to this group were tried; of the pressors pilocarpin, physostigmin and muscarin were examined, and for the depressor effect atropin sulphate was employed. It was found that all of the prostate preparations with the exception of the rabbit's prostate either responded very feebly or not at all to the effects of any of the above drugs. Even when a prostate preparation was brought into a state of contraction with epinephrin the atropin failed to relax the same. Waddell in his experiments describes a contraction produced by pilocarpin on the rabbit's prostate. The present author after numerous experiments with the rabbit's prostate corroborated Waddell's observations but only in a certain number of cases. Some of the rabbit's prostatic preparations responded with a slight contraction to pilocarpin or physostigmin while others failed to contract at all. The conclusions drawn from the above experiments would seem to indicate the absence of parasympathetic elements in the prostatic tissues of the animals studied, with the exception of the rabbit.

## EFFECT OF BARIUM AND PAPAVERIN

Experiments with barium were found to produce a powerful and long lasting contraction of the prostatic preparations. Experiments with papaverin produced a marked relaxation of the prostatic preparations. These drugs are universally regarded as acting upon the muscle cells directly and the results obtained with them are such as were to be expected. Their action was a positive proof of the presence of muscle tissue in the preparations examined.

## DISCUSSION

The motor and secretory innervation of the prostatic gland as given by anatomists and physiologists is derived from the hypogastrics and the *nervi erigentes*. Eckhard (3) produced ejaculation of prostatic secretion on stimulating the *nervus erigens*. Continuous stimulation of the same however failed

to produce further secretion. These observations indicated that the *nervus erigens* supplied the musculature but not the glandular portions of the prostate gland. Mislowsky and Bormann (4) stimulated prostatic secretion by excitation of the *hypogastric nerves*. This secretion was found by those authors to be inhibited by atropin and stimulated by pilocarpin thus indicating that these do affect the glandular activity of the prostate. The same authors however failed to inhibit the ejaculatory function of the prostatic muscle on treatment with atropin and subsequent stimulation of the hypogastrics. It would thus appear from their experiments that as far as the prostatic musculature is concerned it is devoid of parasympathetic terminals. The results obtained in the present investigation would seem to corroborate this view. The present author found a marked response on the part of prostatic muscle to treatment with epinephrin and ergotoxin on the one hand. On the other hand there was no response (with the exception of the rabbit's prostate) to the treatment with parasympathetic drugs. It is needless to state that in the present experiments the data obtained are to be ascribed only to the effects on prostatic muscle. Of course, by the present method of study the effects on the secretory function of the prostate do not come into consideration. The anomalous or exceptional behavior of the rabbit's prostate as compared with that of other animals is not entirely surprising. It is well known that the rabbit's organs are different from those of other animals in many respects. Thus, for instance, the present author is carrying on experiments concerning the comparative effect of pituitary extract and histamine on the urinary bladder and has found that whereas the bladders of most animals are affected more powerfully by histamine than by pituitary extract the bladder of the rabbit gives reverse results. The response of prostatic preparations to barium and papaverin are merely indications of the presence of large amounts of smooth muscle tissue in the specimens studied. The very slight effect of nicotine would seem to indicate a paucity of ganglionic cells in the prostate gland. On the other hand the failure of the prostate to respond to the parasympathetic drugs while

responding powerfully to epinephrin and ergotoxin is a pretty positive indication that the prostate gland is supplied chiefly, if not entirely, by the true sympathetic. While the above experiments were made for the most part, on the prostates of lower animals a few experiments were performed on bits of human prostate (slightly hypertrophied) obtained from the operating room which showed that the latter behaved exactly like that of the majority of other animals.

#### SUMMARY

1. The effects of various drugs were studied on strips of surviving excised prostate gland of different animals.
2. The preparations responded promptly with contraction to barium chloride and with relaxation to papaverin hydrochloride, thus indicating the presence of muscle tissue.
3. The preparations responded distinctly to treatment with epinephrin and ergotoxin but failed to respond (with the exception of the rabbit's prostate) to treatment with pilocarpin, physostigmin, muscarin and atropin.
4. These observations speak in favor of a true sympathetic innervation of the prostate gland.

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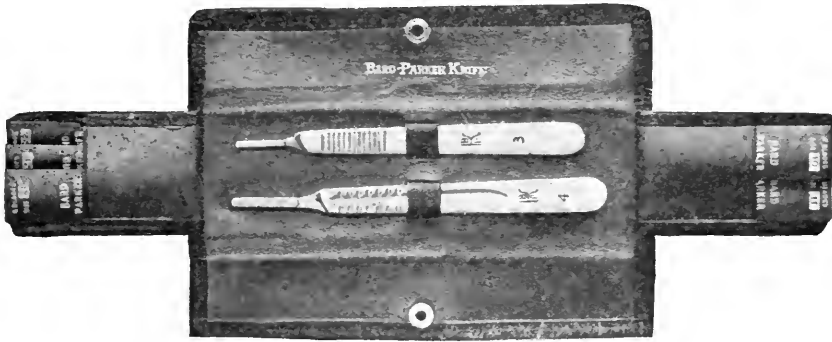
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- (3) ECKHARDT: Beiträge z. Anat. u. Physiol., 1863, iii.
- (4) MISLAWSKY AND BORMANN: Ztblt. f. Physiol., 1898, xii.



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PUBLISHED QUARTERLY  
Beginning May, 1922

WILLIAMS & WILKINS COMPANY  
*Publishers of Scientific Journals and Books*  
BALTIMORE, U. S. A.

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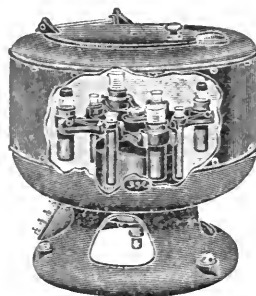
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## SOME DISPUTED POINTS REGARDING PROSTATECTOMY<sup>1</sup>

ARTHUR L. CHUTE

*Boston*

Perhaps the word "disputed" in my title is too strong for the paper that I am going to present. Very likely I would have done better to say that I proposed to discuss some points regarding which there is not perfect unanimity of opinion.

There is a great difference in the opinion of various operators as to what constitutes a clear indication for prostatectomy in patients suffering from prostatic obstruction of a benign type. Naturally the most urgent indications for operation are those signs that point most clearly to dangerous interference with the function of vital organs. In cases of prostatic obstruction the most urgent indications oddly enough, do not direct our attention particularly to the bladder. The cases that are most in need of operation are those whose overdistended bladders have so interfered with their renal function, by means of backpressure, often through a normal ureter, as to cause the toxic or pre-uremic condition that is sometimes called "cachexia urinaria" or "dyspepsia urinaria." These patients usually have some frequency and on examination their bladders can be felt extending well up toward the umbilicus, but the symptoms that they complain of are lack of appetite, pain in the stomach, nausea and at times vomiting, pallor, loss of strength and weight. A patient of this type entered a hospital under my care just before I went on my vacation. He had lost 25 pounds within a short time, had the pallor of advanced malignant disease, could not eat, was nauseated, had constant pain in his epigastrium and looked like a case of advanced cancer of the stomach. He came in because it

<sup>1</sup> Read before the New England Branch of the American Urological Association on November 17, 1921. Discussion of this paper is on p. 445.

it had been necessary to catheterize him for three days previous to his entrance and his bladder was at his umbilicus. Though I believed he represented a case of cachexia uremia I was not sure, and I had the medical men go over him carefully; at first they thought that he was suffering from malignant disease of the digestive tract but they were not able to demonstrate this by most careful and painstaking study. I opened his bladder and during my absence Doctor Smith enucleated this man's prostate. He went home free of his digestive symptoms and gaining fast in weight and color.<sup>2</sup> A condition such as this, is what I believe is the most urgent indication for prostatectomy because in such an instance the kidney, a very vital organ, has been so interfered with as to produce an almost fatal toxemia. Another very definite indication for operation is the nocturnal incontinence that we often see in prostatics. This indicates a chronically overdistended bladder whose back-pressure is probably very considerable but has produced less renal embarrassment than in the preceding type of case. So we go on down the line with our chronic retention or residual urine, the principal element of danger in these cases though not of course the only one; with the diminishing amounts the indication for operation becomes less urgent. I ordinarily place the smallest residual that is an indication for operation at from 6 to 8 ounces, if the residual urine is clear; at from 4 to 6 ounces, if the urine is turbid. An acute retention is not as definite an indication for operation as a chronic retention, though it may be a sufficient indication for prostatectomy. Other things being equal, an infected residual urine makes the indication for operation more urgent than if there was no infection, since it renders it possible that the kidney may suffer from an actual destruction of tissue in addition to the effect that the back-pressure produces. While the indication for operation is more urgent in the cases with infected urine, the danger of operation is as a rule less than in the cases with an uninfected urine, since the infected cases have developed a certain immunity not present in the uninfected cases. Bleeding may be a clear indication for

<sup>2</sup> Six months after operation he reported he "had not been so well in twenty years."

prostatectomy, both the profuse bleedings in which the bladder is filled with clots and the less profuse but continued ones in which the loss of blood is sufficient to weaken the patient.

The subjective symptoms that are referred to the bladder, frequent, painful and difficult urination, are less urgent indications for operation than those symptoms that point to renal embarrassment. When they reach the point where they interfere to any considerable extent with the activity or comfort of the patient, they are sufficient indications for prostatectomy.

The above are general indications that have to be adapted to the case in hand. Thus one would be justified in operating for a less urgent indication upon a man who had to travel a good deal and who was apt to be at times beyond the reach of expert surgical care, than he would be upon a patient who was always within easy reach of surgical attention. In a general way one may operate upon a man in good general condition for a less urgent indication than he would be justified in operating upon a man in a less good condition. So too the man with a large experience and low mortality may operate for a less urgent indication than the man whose success has been small and whose experience has been limited.

Another point that I wish to bring up is regarding the value of the output of phenolsulphonephthalein as an indication of the operability of patients in whom we are considering prostatectomy. We continually see the output of phthalein quoted in case reports as though it were of vital importance in this sort of case. As an index of the renal activity at the moment the test is made, I will agree that it is of value, but it gives us no idea of the potential power of a kidney so that in cases of this sort I have quite given up its use as being of little help. When a kidney has been embarrassed by the back-pressure of a distended bladder, as is the condition in practically all the severe cases that come to prostatectomy, and is getting through almost no solids, it will often put through no phenolsulphonephthalein or so little that it must be called simply a trace. A kidney of this sort may, however, be doing very well a few weeks after the back-pressure of an overdistended bladder has been removed. My

contention is that the important point for us is not what the kidney of this type is doing at the moment of the test but what it is capable of being made to do; this the phenolsulphonephthalein will not show; and furthermore, I have seen a number of patients who were advised against operation because their phenolsulphonephthalein was low, but who nevertheless bore operation perfectly well and made a good recovery. Valuable as I believe this test is as an index of kidney activity when there is no embarrassment in the way of back-pressure, I believe the advantage to be gained from its use as an indication of the operability of a patient whose prostate we wish to remove is very doubtful; that some people will be actually misled by its use and hesitate to give operative relief to patients whose condition really warrants that they should be given this relief.

I have recently been going over the records of the somewhat more than five hundred prostatectomies that I have done. I have found that in the last series of one hundred I lost six cases. My mortality is based on the number of those, who following prostatectomy, die in the hospital from whatever cause. This 6 per cent was too high a mortality, mostly due to an unfortunately large number of men in this series of cases who had serious heart lesion of which they died before leaving the hospital; three of them living more than three weeks after operation. The mortality then for prostatectomy in this series of one hundred cases was 6 per cent. But there is another phase of this subject we must consider. During the same period I saw ten other men with *overdistended bladders* who died as the result of their back-pressure; these men died as a result of their prostatic obstruction, but not following prostatectomy. They were men whom I could not get sufficiently well prepared to allow prostatectomy. Some of these men were evidently in very bad condition, others were in what seemed to be fair condition; in not one of them did I attempt the immediate removal by enucleation of the obstructing prostate; the most that I attempted was the relief of their back-pressure and this almost always by cystostomy under novocain; in three there had been catheter drainage for some time but with the steady failure of the patient so that this was superseded by an



opening of the bladder in the hope that this would prove more effective.

In my opinion the preparatory treatment of the prostatic with the overdistended bladder is the most important and most difficult question we have before us today. I believe we are all pretty much agreed that we may not with impunity remove the prostate of the patient who has been suffering from a chronically overdistended bladder until we have given him some preparatory treatment. As to what this treatment shall be, I believe that we are far from agreed. Some advocate suprapubic incision and drainage, others an inlying catheter, again some champion intermittent catheterization, still others a catheter introduced through a suprapubic trocar. The three last I think come under the head of catheterization and have the weak point that they, if carried out for any considerable time, invariably lead to infection in bladders of this type—that the blocking of the catheter in the presence of infection or bleeding leads to an intermittent drainage that facilitates the upward spread of the infection. I believe any one who has watched many cases of this type must agree that the infection ascends from the bladder to the kidneys in some fashion, presumably going up a ureter, but be the mechanism what it may, that an infected residual greatly increases the danger of renal complications. A point that I think substantiates this is the frequency with which we see a pyelitis during a convalescence from any operation in which the bladder has been opened; this pyelitis often comes on just at the time that the bladder begins to be distended with urine which is naturally infected; it seems to me that the relation between the beginning accumulation of urine in the bladder and the infection in the kidney in such cases is more than accidental. Believing as I do that continuous drainage is more efficient than drainage that is interrupted, I prefer on the whole, the suprapubic incision with a big tube to any type of catheter drainage, in other words, the two-stage operation. I think that the increased shock of the suprapubic incision is more than offset by the better drainage.

It seems to me that there are probably a certain number of these men with overdistended bladders whom we cannot save by any

means, that one naturally gets the best results with the manœuvre with which he is most familiar; hence the strong advocacy of one method by one man and the equal championing of another method by a second man. When I hear a man who is an enthusiast over catheter drainage, as the proper preliminary for prostatectomy, I go home convinced that he is right and I try it again but with the same results that it gave some years ago, namely, that most of the patients do well but that there still remains the small number who do not do well just as with the preliminary cystostomy. I do not know what the factor is that determines this. I see men who I fear will not do well, get along nicely, while others who apparently have no severer type of renal or cardiac trouble go down hill in spite of all that one can do. In a general way the cases that do badly I am convinced do so because of their renal or cardiac condition or the combination of both, but just how to measure this accurately, just how it differs in these patients from the condition that appears similar in other patients who, however, do perfectly well, and just how best to meet it, are points upon which I want more light.

I think, as I said previously, we all agree that preparatory drainage is needed in these cases with overdilated bladders but I do not believe that all the advantage lies with any particular way; that the best results will as a rule come from the use of the method with which the operator is most familiar; that, for me, is the suprapubic incision.

Two of the points that I wish to bring to your attention concern the malignant prostate. The first of these is whether or not we shall attempt the surgical removal of cancer of the prostate. There are a few people who evidently believe that these cases should be allowed to get on with a catheter and morphia as long as they can; then have suprapubic drainage and more morphia until the end. This seems to me quite unsurgical and I feel very strongly that these people should as a rule be operated upon, more especially when they show any residual. They are subject to the same dangers from back-pressure as are the patients who have obstruction due to non-malignant prostates. This back-pressure in itself is a sufficient cause for the removal of a prostate whether benign or malignant.

The general concensus of opinion seems to be that radium has some beneficial action on these growths. If this is true, it seems to me there can be no gainsaying the fact that the less tissue on which a given amount of radium has to act, the more thorough that action will be. It is my belief that instead of applying radium through the urethra, the rectum, or through the perineum we should first proceed to the orderly and careful removal of the bulk of the malignant prostate and should then apply the radium to the remaining portion through our perineal incision.

It has seemed to me that any attempt to remove a cancer of the prostate which was sufficiently evident to make a preoperative diagnosis possible should only be done through the perineum. I have occasionally succeeded in removing by the suprapubic route more or less successfully a prostate that was evidently malignant, but the nature of which I had not previously recognized, but I have, however, seen a great many more which it was impossible for me to remove by this route. In the case of the malignant prostate the perineal route seems to me not only to offer the most direct approach for removing the obstruction and removing the greatest amount of malignant tissue but it seems to me to offer the very best opportunity for so applying our radium as to destroy the greatest amount of the remaining tissue. It is as yet too soon, of course, to attempt statistics on this question but from the ordinary, so-called common sense point of view, it seems to be desirable to remove all the malignant tissue we can before attempting the use of radium, that the less the bulk of tissue remaining, the better the chance the radium has of destroying it.

There is another thing which I think should be considered in the preoperative use of radium. I may be wrong in my estimation of these cases but I have seen one or two instances in which there has been an entire lack of healing following a prostatectomy for malignant disease in cases where there had been a long course of radium previous to operation. It is my belief that this condition was largely the result of the devitalizing action of the radium on the tissues. This, so far as we know, is at its height quite a number of weeks after the application of the radium. I have

seen this devitalization appear to a very marked degree in the case of tumors of the bladder, which I have treated by the introduction of radium through a suprapubic incision; it is often a long time before the suprapubic incision will clear up and close and I believe that probably the same condition exists in the use of radium in the malignant prostate. In the case of the malignant prostate we can only hope to destroy the local mass of malignant disease; the metastases, if there are any, are not going to be affected. It, therefore, seems to me in cases in which the diagnosis is evident that we should remove the malignant tissue at once, subjecting the remainder of the tissue to the influence of radium as soon as possible. I feel that in this way we shall get our best results, that the preliminary use of radium is probably misplaced zeal, that we waste our radiation on tissue that may be removed physically. I likewise am firmly convinced that the use of radium over a period of several months prior to operation increases the danger of possible metastasis very materially. A third reason for avoiding this preliminary use of radium is the devitalizing action on the tissue. The early removal of the greatest possible amount of cancerous tissue by the perineal route and the immediate application of radium to the sides of the cavity, in my belief, allows us to dispose of the greatest bulk of malignant tissue in the quickest time, a thing which we all consider extremely important in dealing with malignant disease in other places and which I believe must be equally important in dealing with malignant disease of the prostate.

Another point that is debatable is the sort of anesthesia that we shall employ in the enucleation of a prostate. I am perfectly convinced in my own mind that while in the two-stage operation we may employ ether with only a moderate risk, it has a greater risk than spinal anesthesia or sacral anesthesia, which seems to be coming in as a substitute for spinal. We know that ether irritates the kidneys definitely and tends to cause their shutting down. We know that this is one of the greatest dangers we have to contend with following prostatectomy.

It is hardly fair for me to express an opinion regarding nitrous oxide for I have used it so little. In most of the instances in

which I have seen nitrous oxide used, though not in all, the anesthesia has been attended with labored respiration and in many instances there has been more or less cyanosis. Very labored respiration and cyanosis, I think, are bad for a patient whose heart is none too good and whose blood vessels are atheromatous and a large proportion of prostatics will show these changes. I feel that spinal anesthesia offers us the rational and, I believe, the safest anesthetic for prostatectomy. It now seems, however, that sacral anesthesia may offer us an even safer means of anesthesia in these cases, but as yet my experience with it is too small to amount to anything. In the last one hundred cases in this series of five hundred prostatectomies I find that I used spinal anesthesia in seventy-six and ether in twenty-four; I think that is about the ratio in which I have used these anesthetics for several years past, but I have not figured out the total number of cases in which I have employed it. I find there is a strong prejudice against spinal anesthesia in most parts of the country and that this has been largely the result of its careless use. Like any other powerful agent the anesthetic must be properly given. I believe, when properly given, spinal anesthesia has almost no danger and spares the kidneys to a great degree. Likewise another point in its favor is the lowering of the blood pressure which gives the vessels in the prostatic cavity a good chance to clot and I believe materially lessens the incidence of hemorrhage following prostatectomy. One cannot say that spinal anesthesia is without its drawbacks. A few times I have been perfectly sure that I was going to lose a patient on the table as a result of toxicity, but I have never lost anybody nor have I lost anybody in whom I thought the spinal anesthesia played a part. I have lost a considerable number of patients, however, in whom I felt sure that ether had been an important factor. As one becomes more and more familiar with spinal anesthesia, I think our uncomfortable episodes with toxicity become less and less and likewise the cases in which we do not have complete anesthesia become fewer. There is one disagreeable feature that we are going to have with this anesthesia until the prejudice against it becomes less, and that is, that every old gentleman who following

prostatectomy has any pain in his back or stiffness in his legs, is going to attribute it to the spinal anesthesia. I have had one or two men of this type, one in particular who was over 80 years old and very feeble. This man had a lot of arthritis of his spine and deformity of various joints. He was perfectly sure that the stiffness which he felt after operation was the result of spinal anesthesia. I am equally sure that it had nothing to do with it. The only unpleasant after-effect that I have known from spinal anesthesia is the spinal headache which occurs in a few cases. When it does occur it is extremely trying. It is, however, usually perfectly controlled by keeping the patient flat on his back and does not subject him to any danger but simply to a moderate amount of discomfort. I do not think I have known any cases in which spinal headache has lasted any longer than ten days to two weeks, and in most cases the duration has been much shorter. Neither of these disadvantages is of much importance when compared with the advantages that spinal has.

Another point on which there is a decided lack of unanimity is whether or not following prostatectomy we should put in a catheter for the new urethra to form over. I am convinced that in my hands this is the wisest thing to do. I think that my deep feeling on this subject arose largely from a very uncomfortable case that I had a number of years ago. In this instance after removing a prostate by the perineal route I did not place a catheter in the urethra but trusted that it would reform as do many more, even now. In this patient, who was a relative of a physician, there seemed to be little tendency for the urine to be passed by the urethra. After a very short time I attempted to pass sounds and I found that the posterior end of the anterior urethra was sealed. I was able by doing a plastic to remedy this condition but it made me feel that for me at least the use of a catheter following prostatectomy was extremely desirable. These malformations of the urethra following prostatectomy in which a catheter has not been used have not been confined to my own experience. I have seen relatively recently two cases in which no catheter was used following operation and where disagreeable complications resulted. The first case was

a man from a neighboring city in whom no catheter had been used. I saw him a year after operation with the posterior end of the anterior part of his urethra entirely sealed up. Of course all the urine was coming through the perineal fistula. This was easily remedied by a plastic. In another patient who was operated on a little more than a year ago by the suprapubic route there exists what is apparently a strictured condition of his deep urethra that gives him a very considerable amount of residual urine and a considerable amount of distress. He has not yet come to his secondary operation. I believe that these results are due largely to the fact that an in-lying catheter was not used in the case of these patients following their prostatectomy. I might add further to the number of cases, in which, due to failure to use a catheter following prostatectomy in instances of both the perineal and suprapubic operation, there has been a deformity of the urethra which has very markedly interfered with urination.

There is no denying the fact that the incidence of epididymitis and periurethral abscess is greater in the cases that have an in-lying catheter. On the other hand I believe that the final result due to the employment of the in-lying catheter, following operation, more than offsets these undesirable complications. It is to be hoped that at a later time we may be able to manage the in-lying catheter so as to get the maximum advantage from its use without the disagreeable incidents which seem now to attend its use.

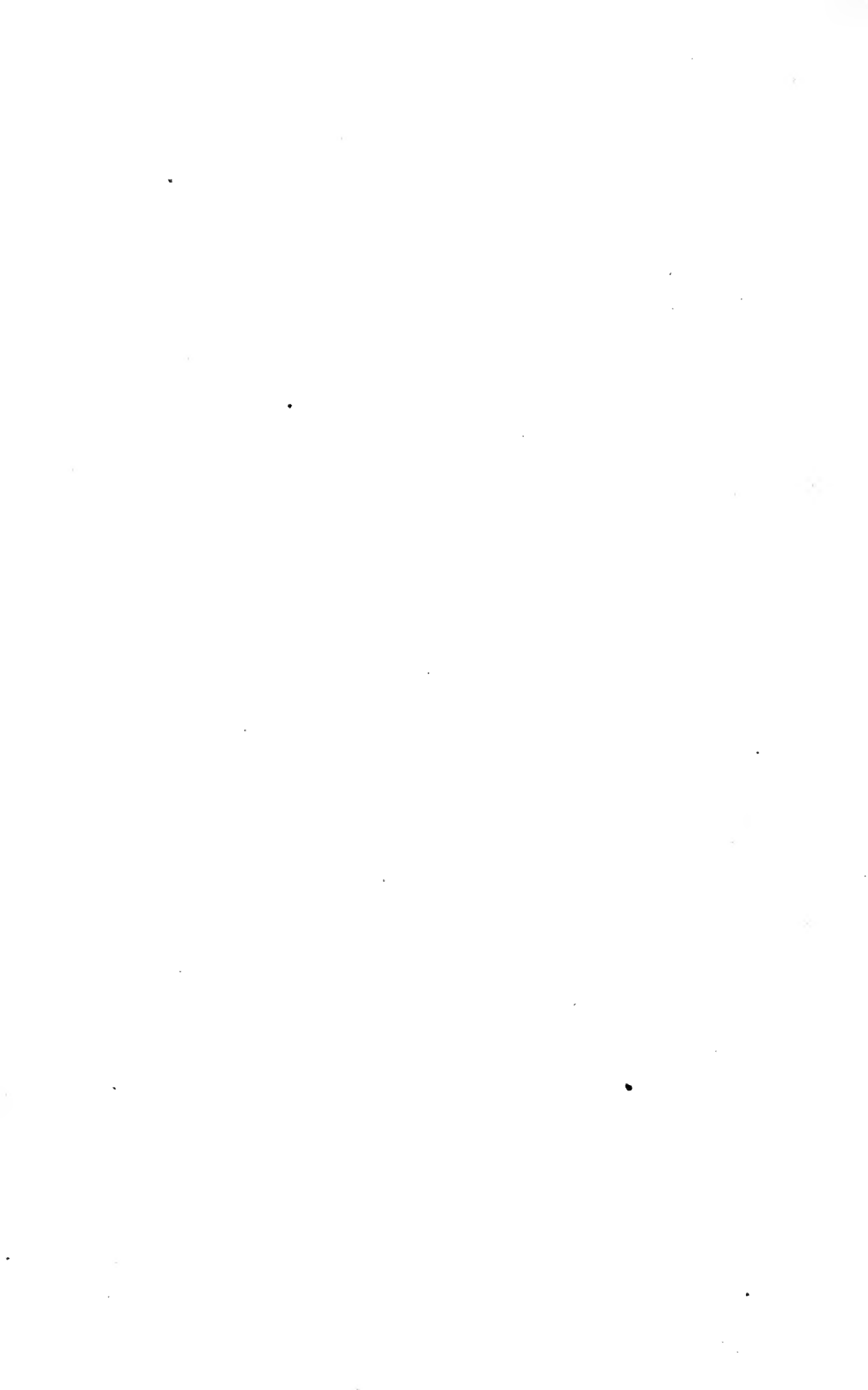
The last point to which I wish to call your attention is the use of water in these patients; especially in the instances where the patients show overdistended bladders. Following the relief of the back-pressure on a kidney which results from obstruction at the bladder outlet and which back-pressure apparently takes place at times through a normal ureter, we often have a congestion of the kidney, sometimes even an inflammatory process. The occurrence of either one of these processes cuts down the kidneys' ability to excrete and unless the condition is met properly it often leads to a surgical uremia which ordinarily proves to be fatal in from three to five days. From such clinical observations

as one has made on cases of this sort it seems evident that a kidney which is the seat of either a very marked congestion or of an inflammation, cannot strain waste products out of a concentrated solution, i.e., blood; that unless we carry the waste products to such kidneys in a very weak solution, they cannot manage to filter them. On the other hand kidneys that are congested or are inflamed, apparently have little difficulty in taking care of a large amount of fluid though they can handle solids in only the weakest solution. It is the concentration that is apparently the obstacle. In order to get work from these embarrassed kidneys and in order to keep down the toxic condition which results from the accumulation of waste products in the body, it is necessary that one get a great deal of fluid into the body that the kidney may carry on its filtration. Where this toxic condition exists there is usually vomiting which will prevent the taking of large amounts of fluid by mouth. The rectal method is not a very sure way of getting large amounts of fluid into the body. We are, therefore, driven to introducing the fluid into the circulation either directly or indirectly: putting the fluid either into a vein or into the subcutaneous tissue whence it is shortly introduced into the circulation. There is some slight difference of opinion as to whether the introduction of fluid into the veins is of greater advantage than the introduction of fluid into the subcutaneous tissues. It seems to me that there can be no doubt that the introduction of a considerable amount of fluid into a vein by the use of some of the new needles is very much easier for the patient, and also very much simpler for the physician. It has seemed to me, however, that the cases where I have seen fluid introduced into a vein have appeared to be more shocked than the cases where the fluid has been introduced subcutaneously. I have felt that the sudden introduction into the circulation of 500 to 1000 cc. of fluid through a vein was a very doubtful procedure because of possible cardiac embarrassment and not a procedure that one would be willing to carry out three times a day for perhaps a week or more, as often happens in these toxic cases. The subcutaneous introduction of salt solution has an advantage in that one has created, so to speak, a supply of available fluid which the



organism can call upon as rapidly as it can care for it. It often requires the introduction of a very large amount of fluid into the circulation of some of these patients, in order to sufficiently wash the blood to prevent a fatal toxemia or uremia. In an excellent paper that Dr. George G. Smith read last year on the subject, he has cited some of the instances in which we gave very great amounts of fluid before we were able to get a patient of this sort disintoxicated, so to speak. In one instance this amount reached 463 ounces or 3.5 gallons. In order to take advantage of these large amounts of fluid one must have a reasonably good heart. This is not always seen in these elderly men and one sees a certain number of patients in whom the kidneys can only prevent a toxic condition by use of more water than the heart is able to manage. I had a very good illustration of this state of affairs as well as a very trying one about a year ago. In this instance, a patient of seventy-one who, following a prostatectomy, had been up and around, suddenly had an exacerbation of an old cardiac condition. From that time on, during the sixteen days that he lived, we had a constant fight between the toxemia due to faulty elimination on the one hand and the overloading of his heart, on the other hand, due to any attempt to give the kidneys enough fluid so that they would clear up his toxic condition. If we gave this man a good amount of salt solution under the skin, he became clear mentally but his cardiac condition became worse; if we let up on his salt solution and kept up with his stimulation, the cardiac condition was better but the toxemia became greater and the mental condition more confused. At the end of sixteen days of this balancing first one way and then the other this man's heart gave out.

I have by no means exhausted the list of debatable points regarding prostatectomy, but if you will remember my title you will see that I only intended to consider "some" disputed points, not all. I trust that I have provided sufficient material for profitable discussion.



## TRANSACTIONS OF THE NEW ENGLAND BRANCH OF THE AMERICAN UROLOGICAL ASSOCIATION

HELD AT THE HARVARD CLUB, BOSTON, NOVEMBER 17, 1921

### PRESENTATION OF CASES

Dr. J. H. CUNNINGHAM, Boston: I have two patients I would like to show on whom I have done a radical operation for carcinoma of the penis according to the technique I presented at the meeting of the American Urological Association in 1914.

The aim of the operative procedure employed on these patients is to remove the penis, the fat carrying the lymphatics, and the lymph nodes all in one mass.

The primary growth in carcinoma of the penis usually involves the distal portion of the penis and metastases take place along the lymphatic channels of the penis to the superficial inguinal nodes, then to the deep inguinal nodes, and then under Poupart's ligament to the iliac nodes within the pelvis. If the urethra has been involved by the growth, metastases may take place through the lymphatic channel, passing over the symphysis directly to the pelvic nodes, spreading the disease beyond the reach of surgery. The lymphatic channels of the lower half of the abdomen drain into the superficial inguinal nodes. It is necessary, therefore, to remove these channels in great part, in order to prevent a lymph block, when all the lymphatic nodes of the inguinal region are removed. The operative procedure is therefore twofold: *First*, to remove the growth and the lymphatic channels through which metastases take place; and *second*, to destroy the secondary lymph-channels which also drain into these nodes.

The technique of the operation is as follows:

1. A condom is placed over the penis to prevent implantation of cancer-cells during the operation.

2. A sweeping U-shaped incision is made, beginning slightly above and to the inner side of the anterior superior spine on one side, downward in the fold of the groin to the root of the penis and upward on the other side. This incision passes just through the skin (fig. 1) and outlines an apron which is dissected upward.

3. An incision passing just through the skin is made downward over Scarpa's triangle from the center of Poupart's ligament. The skin is dissected inward and outward making two flaps (fig. 1).

4. Beginning at the top of the abdominal incision, the fat which contains lymphatic channels is dissected in one mass from the abdominal

fascia. This dissection is carried downward into Scarpa's triangle on either side. The superficial nodes are removed still imbedded in the fat if possible. Hemorrhage during the abdominal portion of the dissection is slight but as the dissection is carried over Poupart's ligament into Scarpa's triangle, the superficial epigastric, the superficial circumflex and the superficial external pudic vessels must be

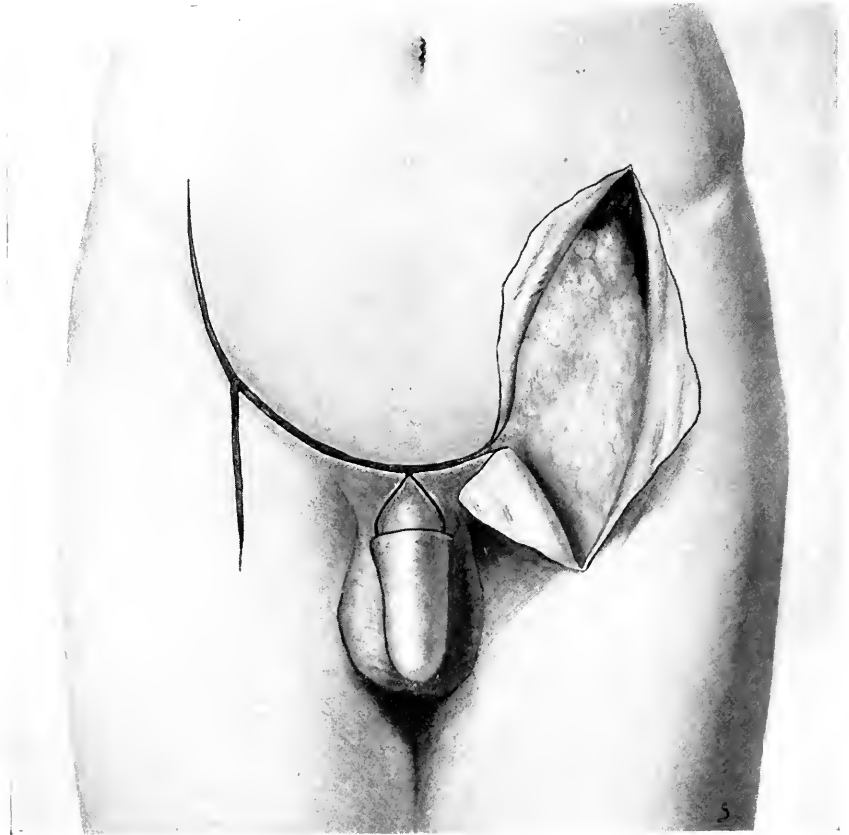


FIG. 1. SHOWS PENIS INCASED IN CONDOM. LINES OF INCISIONS. ABDOMINAL AND INGUINAL FAT MASS PARTIALLY FREED

secured beneath the fat mass as they come through the fascia. If the node involvement is marked, the growth may extend as one mass through the fascia lata into the deep inguinal nodes, in which event the fascia is divided. The sartorius is drawn outward if necessary and the involved nodes freed from the femoral vessels. Poupart's ligament may be divided to continue the dissection into the crural

canal. If the mass is not continuous from the superficial to the deep nodes, the fascia lata is divided and the deep nodes freed from the femoral vessels and removed.

5. The patient is then placed in the lithotomy position. An incision is begun at the root of the penis passing around both sides, uniting beneath and continuing along the raphe of the scrotum, bisecting it.



FIG. 2. SHOWS THE SCROTUM PARTIALLY BISECTED. THE DORSAL VEINS TIED.  
THE CRURA SEPARATED FROM THE PUBIC RAMI AND THEIR STUMPS TIED.  
THE MEMBRANOUS URETHRA SEPARATED FROM THE BULB.  
THE ABDOMINAL FAT MASS ABOVE

The suspensory ligament is divided and the dorsal vessels of the penis secured. The penis with the attached fat mass from the abdomen and groins is drawn downward. The dissection is carried on until the attachment of the crura to the pubic rami are met. These are clamped close to the bone and cut away. The stump is transfixed and tied and no hemorrhage results (fig. 2). It is necessary to clamp, transfix and

tie, for the arteries to the crura may otherwise retract and cause troublesome hemorrhage. Then the corpus spongiosum is freed at a distance of about three-fourths of an inch in front of the bulb and cut across at this point, unless the membranous urethra seems sufficiently long. It is better to leave too much than too little urethra. The whole mass, the abdominal and inguinal fat containing lymphatics and nodes, the penis and the crura, are then removed in one mass.

6. The cut end of the urethra is then stretched to the lower part of the perineal incision, leaving about three-quarters of an inch of it protruding beyond the surface. This is cut away about ten days later,

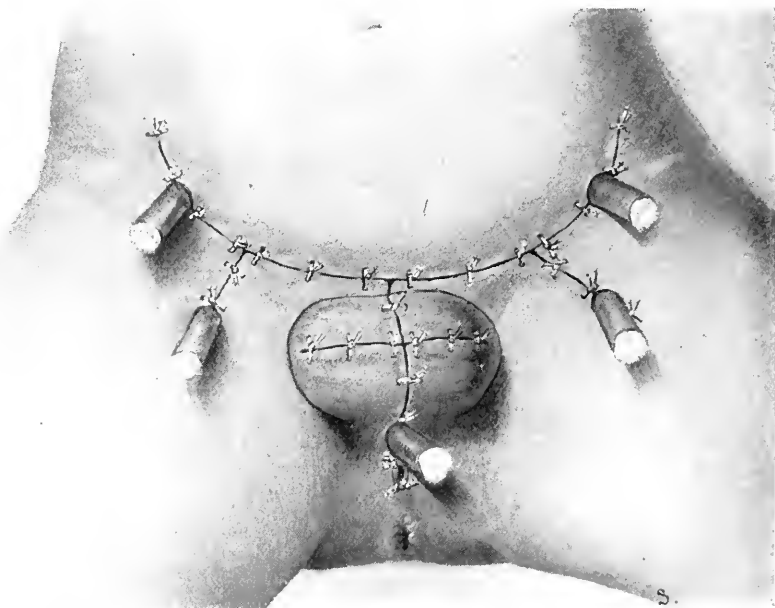


FIG. 3. SHOWS THE WOUND CLOSED WITH DRAINAGE. THE URETHRA STITCHED IN THE PERINEUM. THE SCROTAL WOUND PARTIALLY CLOSED IN THE LINE OF INCISION AND PARTIALLY BY CONVERTING THE INCISION INTO A LATERAL WOUND

after the incision has closed, and stricture is less likely to result. A self-retaining catheter is placed through the urethra into the bladder. A drain is placed in the perineum, also in the wound of the abdominal skin apron on either side, and in the incision in both Scarpa's triangles (fig. 3).

7. The suturing of the scrotum, so that it is lifted upward, so that it will not become soiled by urine is important.

Case 1. S. J. B., age, forty-two. Referred by Dr. F. H. Merriam, South Braintree. Seen April 23, 1919, with a past history of no venereal infections, but a long and tight foreskin since birth.

The present illness dated back several weeks when there was noticed a swelling of the foreskin with some discharge from beneath it. A circumcision was done by another surgeon and a fungating mass disclosed which bled profusely. A Wassermann test taken at that time was negative.

The physical examination showed the recent circumcision wound to be clean and on the dorsum of the glans penis was an ulcerated rather irregular mass, the size of a quarter, covered with granulation tissue, giving the clinical picture of carcinoma. There was a large fusiform chain of glands in both inguinal regions, most marked on the right, and the glands were palpable in Scarpa's triangle. The testicles and scrotum were normal.

Operation: The glands in the inguinal region were removed with those of Scarpa's triangle and the penis, together with both crura in one piece. The urethra was brought out through the end of the perineal incision and a self-retaining catheter placed in the bladder. Figure 4 shows the gross specimen.

A pathological diagnosis showed the growth to be carcinoma. The patient remained in the hospital until May 20, 1919 (20 days), when he left with the wound healed and perfect control of urination. His weight at that time was 140 pounds.

Excepting for a moderate lymph scrotum there has been no evidence of local disturbance. During the year following the patient has gained 40 odd pounds in weight and the urethra has not contracted. At present there is no evidence of recurrence and the patient has been entirely free from symptoms.

Case 2. A. H. F., age, fifty-eight. Referred by Dr. P. J. Finnegan, Cambridge. Seen on August 24, 1920, with a past history that he has always, since youth, had warts appearing underneath the foreskin, which has always been long, which warts have been removed by caustic many times, only to recur.

Four years ago a circumcision was done by another surgeon on account of numerous warts. The warts were then treated and disappeared. Two years ago a thickening appeared on the glans penis which subsequently ulcerated and became covered with a scab which he has removed from time to time. A warty, villous-like growth appeared on the left side of the penis in the region of the corona a few months ago, and three weeks ago bled profusely without known cause.

The local examination shows, on the left side of the glans penis and extending into the sulcus above the corona an ulcerated papillomatous lesion about the size of a dime, with induration of the surrounding tissue. On the dorsum of the glans on the right side there is another smaller area with induration and ulceration. In each inguinal region there is a direct hernia, on the right the size of a lemon, and on the left slightly smaller. A large fusiform chain of glands is present in both inguinal regions and extends downward in to Scarpa's triangle on both sides. The patient's general condition shows no definite defects.

Operation: The inguinal nodes and those in Scarpa's triangle together with the penis, including the crura, were removed in one piece.

Both testicles were removed. The urethra was brought out at the lowest portion of the inguinal incision, and a self-retaining catheter passed into the bladder. The inguinal hernia on either side was repaired as thoroughly as possible under the existing circumstances. Figure 4 shows the gross specimen.

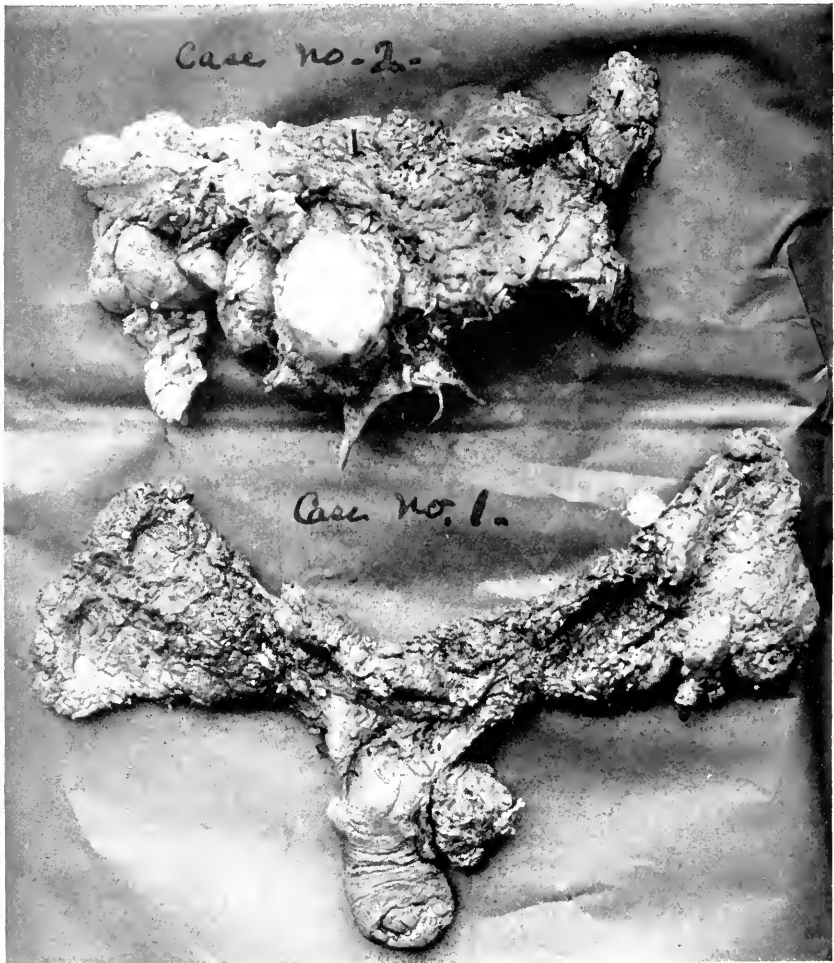


FIG. 4. TISSUES REMOVED AT OPERATION

There was some sloughing of the flap in the inguinal region requiring a subsequent skin graft. There have been no symptoms or evidence of recurrence of the disease and the urethra has not contracted. The patient has gained 45 pounds in weight.



Both of these patients have received a course of radium over the field of operation, one five and one six months ago, purely as a palliative measure. This I intend to repeat.

Dr. H. T. HOYE, Providence: I wish to report the following case of hypernephroma occurring in a machinist forty-two years of age.

*Chief complaint:* Hematuria for three days.

*Family history:* Negative.

*Past history:* Married twenty years. Five children; wife has had no miscarriages, has always been well. Denied venereal disease. Formerly drank 2 to 3 beers daily. No nocturia until present illness; adds that he has had asthma at times for twenty years.

*Present illness:* Commenced two months ago. Left side of scrotum enlarged and seemed to slip down; wore a suspensory to support varicose veins then. Up to three days ago, he felt very well except for varicocele. He then commenced to pass by urethra dark, thick blood with much frequency; much dysuria. Consulted his physician who thought he might have been injured while at work and that he came under the Workmen's Compensation Act. No loss of weight. On urinating, he at times has sharp pain starting in region of left kidney and following the course of the ureter; no stones noted in urine.

*Physical examination:* Fairly well developed and nourished. *Chest:* Heart is negative. *Lungs:* Many music box râles both left and right. Antero-posterior diameter of chest is increased above normal. *Abdomen:* There is a large mass in upper left quadrant, extending from about mid line into the flank and back; does not move on respiration. It is slightly tender to palpation. There is an inguinal hernia on each side and varicocele on the left side with testicle of softer consistence than normal. *Urine:* Alkaline, 1.012 specific gravity; large amount of albumin; no sugar; macroscopic blood.

Phenolsulphonaphthalein test could not be done on account of blood. Seventeen milligrams urea per 100 cc. blood. White blood corpuscles, 12,200. Red blood corpuscles, 3,920,000.

*Cystoscopy:* October 22. Attempt made to catheterize ureters but unsuccessful by reason of bloody urine.

*X-ray:* October 24. Examination for stone in genito-urinary tract is negative. October 28. The right kidney is distinctly seen. The left kidney outlines cannot be seen. There is general blurring of outlines in the left kidney region which could be due to a tumor.

*Operation:* October 29. Lumbar incision. Kidney delivered with some difficulty; large tortuous veins running over its capsule. Large cystic mass size of a large orange, occupying lower pole of kidney; upper pole apparently normal. Nephrectomy. Cigarette drain.

Patient made uninterrupted recovery. One stitch abscess.

*Pathological diagnosis:* Hypernephroma of left kidney with extension to the renal vein. X-ray examination of chest. November 17. Renal function 45 per cent phenolsulphonaphthalein. Blood Urea 17 milligrams per 100 cc.

*X-ray interpretation:* November 10. Examination of the chest: There are extensive peribronchial changes, especially in the right lung, the changes being most marked in the middle third. These findings are strongly suggestive of metastatic malignant disease.

Dr. R. F. O'NEIL, Boston: In regard to hypernephroma the following observation is of interest. The patient was referred to the Genito-Urinary Department at the Massachusetts General Hospital from the Orthopedic Department with a question of "any cause in the Genito-Urinary tract for some areas of new growths in some of the long bones and in the skull?" There were no urinary symptoms whatsoever and the kidneys could not be felt. However we did a bilateral pyelogram which showed a distinctly abnormal pelvis in one kidney. We expressed the opinion that this kidney was probably the site of a tumor and that metastasis had taken place before the original growth had given rise to clinical symptoms.

Dr. W. D. BIEBERBACH, Worcester: I wish to report this case as a matter of record in regard to age, size of prostate and recovery. Patient, a Canadian, aged ninety-one, was admitted to the Hospital June 1, 1921, suffering from acute retention. He had always been a hard working man and recalls no illness except seventeen years ago when he had an attack of acute retention and had to be catheterized for about two weeks. This was followed by a course of dilatation. Following this trouble he has had an increasing difficulty in urination associated with nocturnal and diurnal frequency with burning on urination. June 1, 1921 he had attack of acute retention and for several hours had been unable to void. Several attempts at catheterization failed and patient was sent to the hospital. Examination: Bladder was distended to the umbilicus and abdominal wall very tender and tense. There was considerable urethral bleeding as a result of attempted catheterization. A soft rubber catheter was introduced into the bladder, but on account of blood clots drainage was poor. It appeared that the patient was having considerable intravesical bleeding with clot formation, and it was deemed wise to carry out a suprapubic cystostomy for proper drainage. The bladder was opened under novocain and large drainage tube inserted. The bladder was found to be filled with bloody urine and many large clots, also a large prostate, nodular and somewhat elastic could be felt covering almost the entire floor of the bladder. The patient improved greatly under suprapubic drainage and on the 16th day following his primary operation it was decided to remove the prostate. On account of his general physical condition together with the fact that many moist râles could be heard at the base of both lungs, it was decided to remove the prostate under spinal anesthesia. The gland was removed in the usual way, but on account of its size and lobulation it had to be removed piecemeal. The patient suffered considerable shock following the spinal anesthesia but otherwise showed no great distress from the operation. His recovery was uneventful except that

in some few days after in the attempt of healing his suprapubic wound an indwelling catheter was used, and the patient developed an acute epididymitis on the right side which went on to suppuration and had to be opened and drained. He is up and about and is in good health for a man of his age today. The diagnosis reported by the pathologist was adenoma of the prostate. The prostate weighed 360 grams.

Dr. CROSBY, Boston: Speaking of large prostates recalls to my mind a prostate which Doctor Chute removed four or five years ago in two pieces. That weighed 420 grams. It was the largest prostate I ever saw.

Dr. R. F. O'NEIL, Boston: I have two pathological specimens which I would like to present to the Society.

The first is that of the prostate which I removed two weeks ago. The patient was a very stout man of seventy years of age. Prostate by rectum was very large; had a typical adenomatous feel. Clinically there was only a small amount of residual present but he had numerous attacks of acute retention which was the reason for operation being advised. He was drained for one week by means of a catheter and the renal function and general condition were excellent. Suprapubic enucleation was performed under spinal anesthesia.

Patient has done very well. (Since reporting this case patient has left the hospital entirely well, with perfect control.)

This specimen is shown on account of its size, as I think it is the largest prostate I have ever removed. I regret that I cannot give the weight but as you see, it is a very large prostate.

The second case is a tumor of the bladder which occurred in a man of fifty-five years of age who gave a history of hematuria for two years. Cystoscopic examination showed a solid, fleshy looking growth at the top of the bladder about the size of a quarter. I had hoped to be able to remove this by suprapubic extra-peritoneal operation but on exposing the bladder the peritoneum was found to be adherent. I then opened the peritoneal cavity, excising the adherent peritoneum, closed the peritoneal cavity, then opened the bladder and excised the growth including the entire thickness of the bladder wall, with a good margin of normal tissue.

The patient made an uninterrupted recovery.

Pathological examination showed the growth to be adeno-carcinoma and the peritoneum although adherent was not involved, the growth having proceeded no further than the muscular coats. There was a good margin of normal tissue.

This case is of interest in that it is one of the few cases of bladder tumors which seemed to hold out a prospect of cure from the location of the growth, which made it possible to excise it entirely.

Both of these cases were referred to me by Dr. Henry J. Perry, for operation.

## AN UNUSUAL CASE OF RENAL CELL ADENOMA

Dr. R. C. GRAVES (by invitation): The case under consideration is that of an American clothing merchant who first came to the Peter Bent Brigham Hospital in 1913. At that time he was fifty-four years of age. His story was of considerable interest. He stated that in 1897, sixteen years before, he had suffered his first attack of bloody urination. This followed a 60-mile bicycle ride. The bleeding was at first slight but it was persistent and progressive. One week after its beginning, it was sufficiently profuse to render the urine jelly-like in consistence. There then began sudden, intense pain in the left lumbar region, radiating forward across the abdomen to the region of the symphysis. There were no other associated symptoms. After several days of rest in bed, the pain subsided and the bleeding ceased.

There was an early recurrence of a similar attack. One year later the patient suffered a third period of hematuria and severe pain. Thereafter, for fifteen years, blood-stained urine was observed perhaps once each year. There was, however, no further pain. The attacks of bleeding were always similar. The patient was of the opinion that they invariably followed hearty meals. Always a slight discoloration of the urine appeared first, followed by a profuse hemorrhage in one to two days. Rest in bed with restricted diet and fluid intake, always gave gradual relief in ten days' time. There were never any other symptoms, either general or local. During the period which has been described, the patient was seen by several physicians and was given both X-ray and cystoscopic examinations. No diagnosis was ever offered.

In 1913, he entered the medical service of the Peter Bent Brigham Hospital. Physical examination found a well developed and well nourished man of middle years. The examination was essentially negative except for the finding of a mass in the region of the left kidney. This was bimanually palpable. It moved with respiration; it was neither hard, nor nodular, nor fluctuant, nor tender. It is described as having been the size of a small grapefruit. The blood picture was normal. The urine contained, microscopically, blood, but neither pus nor casts. A guinea-pig inoculation test for tuberculosis was subsequently reported to be negative. The excretion of phenolsolphonephthalein was 60 per cent in two hours. Routine X-ray studies showed no abnormal shadows. A cystoscopic examination is reported to have been entirely unsatisfactory because of an extremely irritable bladder. The patient decided to return to his home to arrange his business affairs, with the understanding that he would promptly reënter the hospital for cystoscopy under anesthesia and for operation if necessary. He was lulled into a false sense of security, however, and he did not appear until 1915. He then stated that there had been no difference in his symptoms, in the time that had elapsed. The physical examination revealed no striking change and no new significant data are recorded. For some reason which is not given, he again left the hospital without treatment.

Nothing more was known of him until June, 1921, when he was readmitted to the Peter Bent Brigham Hospital, this time on the Surgical Service. It is of interest that this was twenty-four years after the time of the initial hematuria. He was sixty-two years of age. He reported that during the long period of his absence he had had three or four attacks of bloody urination each year, with occasional slight discomfort in the left side after the cessation of the bleeding. Two years before his return, in 1919, he first observed for himself the presence of a mass in his upper left abdomen. He felt that at about that time his hematuria began to occur somewhat more frequently. His general health, however, seemed to be in no way affected. The final attack which led to his last hospital admission, began one month before. The bleeding was excessive and for the first time there was slight loss of weight and extreme loss of strength.

Physical examination found a well developed male of advanced years, who presented evidences of profuse hemorrhage. He was weak and very pale. His hemoglobin was 35 per cent; the red blood count was 2,700,000. The blood pressure was: systolic, 90; diastolic, 50. The urine was grossly bloody but it contained neither pus nor casts. The patient had no fever. The interest of the physical examination centered in the left upper abdomen. There could be palpated a firm, slightly irregular mass which extended well below the costal border and which entirely filled the flank. It extended to the right beyond the midline. It was bimanually palpable, and moved slightly with respiration. It was not tender.

A transfusion of whole blood was given with marked benefit which might be expected. A cystoscopic examination was later attempted but without complete success. In the presence of an extremely irritable bladder it was possible only to catheterize the right ureter and to obtain therefrom normal urine containing a satisfactory percentage of dye. A few questionably cloudy jets were seen from the left ureteral orifice. A pyelogram could not be made, of course, and the routine X-ray studies were of little value.

The differential diagnosis was extremely interesting but for that we have no time this evening. The case was obviously one of renal neoplasm of some type. Whatever its final condition, it must have been benign throughout the major portion of its course. A papillomatous tumor of the kidney pelvis was strongly suggested. When the condition of the patient warranted the procedure, operation was performed by Doctor Quinby. The posterior extra-peritoneal approach was chosen. A very large, widely adherent tumor of the left kidney was found. It soon became apparent that the successful removal of the mass involved the inevitable loss of the patient. A two-stage operation was therefore decided upon. The region about the kidney, as far as it had been freed, was packed with gauze, and one rather large vessel entering the tumor was ligated. This last measure proved subsequently to be of considerable assistance in lessening the size of the growth. The wound was left open. The immediate convalescence was a stormy one.

and a second transfusion was necessary. There developed a small amount of low-grade wound infection. In two weeks' time, however, it was possible to perform the second operation. At that time the anterior transperitoneal route was used. The tumor was found to be densely adherent to the peritoneum and included in the adhesions was the mesentery of the sigmoid flexure. In the latter structure was found a chain of moderately large, red, succulent lymph nodes. Because of the size and extent of the involvement; because of the glandular pathology and because of a tentative report from the pathological department, suggesting metastatic malignancy, it was deemed wise to desist in the face of inoperability. The patient made a prompt recovery. Careful microscopic study of the tissue removed gave no evidence of tumor growth, in the neighboring lymph glands above described. The gross appearance of involvement had apparently been due to extension of infection from the wound posteriorly. There was no reason, therefore, to consider the case a hopeless one. The patient was consulted and it was his decision that a third and final attempt be made.

Two weeks after the second operation, a third operation was performed. On this occasion, Doctor Quinby successfully removed the entire mass, using again the anterior, trans-peritoneal route. At the close of the procedure a transfusion was given. The convalescence was satisfactory and the patient was discharged in good condition one month later, in September, 1921. He was seen again yesterday (November 16). He has gained 35 pounds in weight and he is in excellent condition.

Sections are available for your microscopic examination at the close of the meeting. The tumor has been reported to be a true renal adenoma of the tubular type. An adenoma of the kidney reaching so great a size is of considerable pathological interest. Clinically, of course, the case is striking in that it offers a picture of intermittent, profuse hematuria of twenty-four years duration, with a massive tumor of the kidney and without considerable effect upon the general health and habits of the individual.

Dr. G. G. SMITH, Boston: This is a kidney from a man, thirty years old, whom I saw with Dr. Harold Giddings. When the patient was nine years old he had pain in the left flank accompanied by hematuria. He had a number of attacks of pain at about that time. They gradually became less frequent and from 1914 to the present time he had been, as far as he knew, perfectly well. He had been accepted for quite large insurance and he considered himself in perfect health. On September 21, coming back on the train from Philadelphia he was seized with a chill and had a very severe pain over the left kidney. Examination showed a tender kidney, enlarged, with a great deal of spasm over the left abdomen. Cystoscopy showed a normal bladder. A catheter went up the right ureter all right, went part way up the left ureter but not completely to the left kidney. A pyclogram on the left side was quite inconclusive though very suggestive. It

showed a shadow of an apparently enlarged kidney on the left with six or seven small shadows of stones toward the outer part. There is just a little of the injecting fluid shown going into the left kidney. We made a diagnosis of a shut-off hydronephrosis on the left side. We were about to operate when he developed an infarct pneumonia in the left lung. Before that he had a persistent temperature and was evidently quite septic. So under gas-oxygen anesthesia I made a small incision exposing the cortex of the kidney and put my finger in and felt the distended interior of the kidney, put in a tube and backed out. After that he developed a phlebitis in the right leg but that quieted down. On November 10, I took out this kidney which is interesting because it shows a very definite kink in the ureter. The ureter can be seen coming off the lower part of the pelvis and I have separated the adhesion which held it on to the pelvis. The ureter was originally turned back on to the pelvis in that manner (showing), and I have separated the adhesions. There is the dilated pelvis and here is the kidney with comparatively little cortex. The stones which were in the kidney are a little different from any stones I have ever seen. Probably because of their formation in this free body of fluid, they were able to form spicules which project for a quarter of an inch on each side. The patient made an excellent convalescence.

#### PRESENTATION OF INSTRUMENTS

Dr. A. L. CHUTE, Boston: I have an instrument here that I would like to show. It is a modification of a tonsil or adenoid rongeur that I use in removing malignant prostates: it has simply been made straighter than it was to facilitate introduction through the perineal wound. I have found it very helpful for this purpose as have some other men who have used it. It is built solidly enough so that the shafts do not spring when one bites hard tissue, a trouble with some instruments of this type. With this I have found it fairly easy to bite out the dense tissue of a carcinoma of the prostate which one has exposed through a perineal incision.

I also wish to present a modification of the regular Mixter tube which I find useful for suprapubic drainage. In this we have taken off one of the two flanges and rounded the end which makes it easy to introduce into a rubber suprapubic tube. It is much easier to introduce than the tube with a double flange and it is of especial advantage in the two-stage prostate operations when one occasionally wishes to change the distance that the glass tube enters the rubber tube.

Dr. W. C. QUINBY, Boston: Regarding Doctor Chute's instrument, I have been in the habit of using the Goodale tonsil punch. There is an inner and outer ring and one ring fits into the other as a circular knife.

Dr. A. L. CHUTE, Boston: Is that the one that comes together with a jaw-like action?

Dr. QUINBY: No, this bites in the opposite direction. It is one circle and then a knife cutting. It isn't a rongeur type but a circular punch and has a little more power.

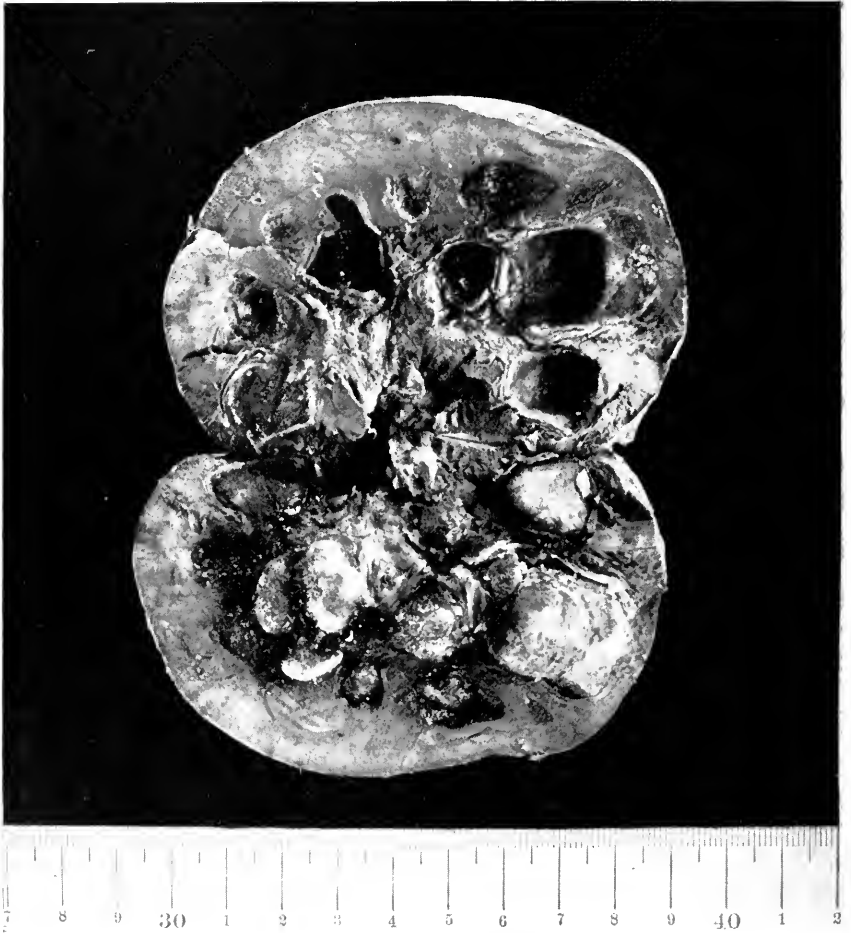


FIG. 5. MULTIPLE CALCULI IN KIDNEY

Dr. O. D. PHELPS, Worcester: I would like to show a specimen and plate from a case of multiple calculi of kidney. A man of thirty who has just had a nephrectomy. One year ago, X-ray was negative and the cystoscope did not reveal sufficient pathology to warrant operation. The plate and specimen are of interest from the number and size of calculi present.



Dr. A. L. CHUTE, Boston, read a paper entitled "Some Disputed Points Regarding Prostatectomy."

Dr. J. H. CUNNINGHAM, Boston: There is, of course, very little in Doctor Chute's presentation of the subject with which to disagree and much with which to agree because the essential features of the prostatic problem are pretty well established among those who have had much experience with the subject. There are, however, a few points which I might speak of chiefly in the way of emphasis.

The first, and by far the most important is the necessity of bladder drainage before the gland is removed. This I think we all appreciate as the feature upon which the safety of prostatectomy depends. How it shall be attained is only a matter of choice with different individuals. That we must have preliminary bladder drainage to improve renal deficiency is well established. This may be accomplished by regular and frequent catheterization, an in-dwelling catheter or by suprapubic cystotomy as the individual case may require. Personally I do not feel that suprapubic cystotomy, as a preliminary step to prostatectomy is imperative in all patients and believe that there are four reasons why it is so generally employed, two of which are justifiable indications and two of which are not. This classification, however, does not in any way apply to or reflect upon Doctor Chute's preference for suprapubic drainage.

The first, and largest class requiring suprapubic drainage, includes those patients, who, from the nature of the obstruction, cannot be catheterized, or being catheterized with or without difficulty, do not tolerate the in-dwelling catheter. The second class includes those patients with marked bladder and renal infection requiring prolonged preliminary bladder drainage and those in whom there is much bleeding into the bladder with or without the complication of bladder stones.

There is evidence, which leads me to believe that suprapubic drainage is sometimes employed for two reasons which I consider unjustifiable; but not without a certain form of reasoning on the part of those employing it. In the first place, it can be readily understood that if one takes the patient to the hospital and does a suprapubic cystotomy, the patient is not going to change his mind about operative interference, as is sometimes the case with the relief of distressing symptoms dependent upon drainage by an in-dwelling catheter; and secondly those interested in their mortality statistics will find that preliminary suprapubic drainage eliminates from the prostatectomy statistics those patients who die during the period of preliminary drainage suprapubically. That patients die during this period of renal adjustment, dependent upon bladder drainage, is well appreciated. As Doctor Chute has mentioned, there are some patients who go down hill and die from no obvious reason during this period, which I presume, is in fact, due to renal impairment. That patients die in the same way from drainage produced by an in-dwelling catheter I know very well, but I cannot help but feel that the more severe procedure of suprapubic drainage

carries a higher mortality than drainage obtained by an in-dwelling catheter. To avoid this additional strain upon the enfeebled individual I personally prefer drainage by an in-dwelling catheter when possible and suprapubic drainage only when necessary.

Doctor Chute's reference to the 'phthalein test as an indication for or against operation I think is very well taken, and it cannot be too strongly emphasized that a single test is no criterion upon which to judge of the patient's potential renal value. The test, however, should not be discarded but employed when the patient first comes under observation and at the same time the blood chemistry should be investigated because these two tests taken together give an estimation of the patient's renal value at that time, so that subsequent tests, both 'phthalein and blood chemistry, can form a basis for further comparison by which we may judge the power of the kidneys to recuperate when bladder and renal retention and infection, if present, are relieved by constant bladder drainage. It is only by these means of observing the diminution in blood nitrogen retention and the increase in the 'phthalein output to a required standard that we may consider a patient suitable for the operation of prostatectomy.

I want to agree in most part with the views expressed in regard to the use of radium in carcinoma of the prostate. I believe that we should, as a rule, remove the carcinomatous prostate which is obstructive, but always with the application of radium at the time the operation is done. The exception to the rule is when the patient has evidence of advanced metastases, in which event I believe the residual urine should be removed by regular catheterization if possible or the establishment of a permanent suprapubic drainage if necessary and the local disease treated by subsequent applications of radium to the gland.

The great danger attending the removal of a carcinomatous prostate, as in any carcinomatous mass which must be cut into, is the increased chance of disseminating the carcinomatous cells by opening blood spaces; and for that reason I think it very important if one is to remove a carcinomatous prostate surgically, that the malignant gland receive a thorough radiation prior to the operation and at the completion of the operation, that radium be left in the prostate region with the end in view to diminish or destroy the vitality of the cells, preoperative, and to destroy cells freed by the operative manipulation. Moreover, the presence of the radium, in large doses, has a beneficial effect upon any remaining carcinomatous tissue, and I think we will all agree that to remove all the malignant tissue in the operation is usually impossible. For this reason, I believe, that intensive postoperative radiation should be employed as routine in an attempt to eradicate the disease locally and prevent recurrent obstruction.

Doctor Chute has said nothing about recurrent urinary obstructions dependent upon a local recurrence of the carcinoma following its surgical removal. I believe that the pre-operative employment of radium; its employment at the time of operation and following the operation will retard such recurrences. I have seen many patients with

recurrent symptoms of retention dependent upon the recurrence of the malignant growth following its surgical removal without combined radium therapy and which patients are no fit subjects for further operative interference. These patients I believe are entitled to whatever benefits may come from the use of radium, together with the other features of treatment usually employed. I have been in the habit of subjecting such patients to what I choose to term "palliative radium treatment" which consists of a thorough radiation of the growth by placing radium, in needles, into the substance of the growth, as advocated by Barringer, and subsequently applying radium locally to the area through the rectum, the urethra, and transvesically as advocated by Young. Not only am I convinced that local benefit is thus obtained, but these poor individuals, as with all carcinomatous patients, require some "crutch" and radium therapy is the only crutch for carcinoma that has a reasonable foundation in fact.

Dr. G. G. SMITH, Boston: There are two or three points in Doctor Chute's very admirable paper which I should like to speak about. In the first place, the question of the use of radium—it has seemed to me from my experience with radium at the Huntington Hospital that to get any real effect from it we have got to cause an actual necrosis of the tissues. I hear reports of other people so influencing the tissues with radium that the prostate will shrink down; but in my experience that can only be accomplished by an actual necrosis of the tissues which you wish to affect. If you apply radium by the urethra, the greatest effect comes on the urethral mucous membrane; if you use it that way you endeavor to screen out the beta rays which are, next to the alpha rays, the ones that burn most. The greatest effect is necessarily upon the urethral mucosa. The rays must pass through that to get into the prostatic tissues. While it is true that malignant tissue responds to radium about four times as easily as normal tissue, yet it is also true that the effect of radium diminishes with the square of the distance away from the radium itself so that as the ray leaves the radium capsule and passes into the prostate its effect is diminished in proportion to the square of the distance of the tissues to be affected from the capsule. So that by the time the radium has gone through the urethral mucosa and gone through the prostatic tissues if it is going to be strong enough to have any effect on carcinoma it has to be powerful enough to destroy the urethral mucosa. The carcinoma which we find in the prostate is generally of the scirrhus type. That is a type largely intermixed with connective tissue and comparatively resistant to radiation.

It is different from the soft papillary tumor of the bladder which perhaps responds quite easily, so that to my way of thinking it doesn't do very much good to use radium in carcinoma of the prostate unless you can get it into the midst of the tissues and then only when you slough out or cause a definite necrosis of the tissues.

With regard to sacral anesthesia—I have been very much interested in that lately and have used it in about ten cases. Doctor Scholl who

was formerly house-officer at the M. G. H. and since then has been working in the Mayo Clinic told me last spring about it and gave me the formula that they had been using out there with good results. So I have tried it and am enthusiastic about it. I have used it in ten cases, two of them suprapubic prostatectomies, second stage, with in one case apparently no pain at all. The other case was that of a very nervous man who, I think, under any form of local anesthesia would have had to have a certain amount of anesthetic. He had a "psychic" ether, just enough to distract his attention. I have used it in cases of perineal prostatectomy and the anesthesia has been perfect—the only drawback is the exaggerated lithotomy position which fatigues the patient. You can put him in the Trendelenberg position without the drug going up into the canal as it does in spinal anesthesia. I believe it is going to have a large field of usefulness and will compete with spinal anesthesia in practically all operations. For instance, the other day I did an emasculation under sacral anesthesia plus novocain injected into the suprapubic tissues and the cords; the anesthesia was very excellent.

With regard to the use of water—there are many problems there that have never been settled. The amount of fluid which the kidneys put out is primarily due to the condition of the filtering membrane of Bowman's capsule; and we don't know exactly what affects that membrane. We do know some things that affect it,—for example, according to Fischer, acidosis local or general decreases the filtering ability of that membrane. Now where we have a sudden congestion of the kidney from emptying of the bladder and a relief of back pressure and the kidneys become congested, it seems very probable that that congestion causes a local increase in acidity, thereby giving one very good reason why Bowman's capsule in those cases does not filter out so much fluid.

I think Doctor Chute is absolutely right in what he said about the use of water and it seems to me that one can find a great many scientific reasons why dilution of the blood stream with water or salt solution will increase the kidney's ability to put out toxins.

Dr. R. F. O'NEIL, Boston: I want to express my appreciation of Doctor Chute's very clear paper and to thank him for again bringing up these much discussed points in the technique of prostatectomy.

In regard to the preliminary suprapubic drainage I feel that while undoubtedly, many cases will do well under urethral drainage, in my experience suprapubic drainage has given the best results in the greatest number of cases and I am convinced that the incidence of renal and prostatic infection is distinctly less by this method.

In regard to anesthesia, I am glad to hear Doctor Chute champion the employment of spinal and sacral anesthesia. I have had no experience with the latter. But I can look back on cases in which the administration of a general anesthesia, such as ether, played a distinct part in the mortality.

I am very much in favor of an in-dwelling catheter after operation, as I have seen several cases of deformity of the bladder neck where it had

not been employed, which resulted in great embarrassment to the patient and to the operator.

There can be no two opinions as to the advisability of the employment of large quantities of fluid following operation. Undoubtedly the subpectoral is the surest and quickest way of giving it. The only objection to the method is the pain caused by the distention of the tissues in thin people. I have heard it stated somewhere that the addition of a small quantity of novocaine reduces this discomfort considerably. I have had no experience with this method and should like to ask if any one present has.

Dr. H. H. HOWARD, Boston: I rather hesitate to take exception to anything Doctor Chute has said. In regard to draining cases after suprapubic prostatectomy—and the use of the in-dwelling catheter—perhaps some of the cases we have done at the City Hospital are cases that Doctor Chute has operated on afterwards; but in the cases we have followed along and tried to get to come back to us we have not as yet run across that difficulty. And I think the reason is this—that in every single instance those cases are dilated on the ninth or tenth day following the enucleation and they are advised to come back to the outpatient department at regular intervals of a week or ten days depending upon what is found, for further dilatation, and in none of those cases have we had any difficulty. I believe there is another added advantage in not using an in-dwelling catheter and that is in irrigating the bladder. We take an ordinary syringe with a urethral tip and start in washing back through the entire urethra and irrigating the bladder that way instead of using the catheter down through the suprapubic tube and it seems to me the irrigating is much more efficient by that method. I don't mean to say that every case is irrigated but in those cases that are irrigated I do think you get better results by irrigating through the penis. We have had one or two cases of epididymitis following the passage of sounds but to my knowledge there have only been two out of a series we have done in the past two years. I should like to know if any of those cases Doctor Chute operated on are cases we handed out to him.

Dr. CHUTE: No.

Dr. HOWARD M. CLUTE, Boston: The question of fluid in postoperative cases is a very important thing to consider and in general surgical work we are using it more and more. We have found in postoperative vomiting following operations of any type that if you give enough fluid subpectorally or any way, it will decrease the nausea and vomiting. Doctor O'Neil spoke of novocain. Doctor Lahey and I have been putting novocain in all subpectoral salt solutions. We put in just a small quantity, the amount being 0.125 gram to 0.250 gram of novocaine in 1000 cc., which will make it practically painless except for the introduction of the needle. In certain cases we freeze the skin with ethyl chloride before introducing the needle and thus render the entire procedure innocuous.

Dr. G. G. SMITH: Do you see any toxic effects at all?

Dr. CLUTE: No, never. We give two or three a day. All thyroid cases receive subpectoral salines as a routine and we give a great number of them and never have any trouble.

Dr. A. L. CHUTE, Boston: I have little to add other than to thank the men for their discussion. They did not disagree with me as much as I had hoped they would.

Doctor Howard shocked me a bit by saying that he was irrigating bladders after prostatectomy. I have felt that it was an unwise practice and have supposed it was little used. It makes it so hard to be sure just how much urine the kidneys are getting out; a most essential thing following prostatectomy.

Dr. HOWARD: I did not mean that in every case.

Adjourned.

## PNEUMOPERITONEUM IN KIDNEY DIAGNOSIS WITH SPECIAL REFERENCE TO THE DETECTION OF RETROPERITONEAL MASSES

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The usefulness of pneumoperitoneum or gas inserted into the peritoneal cavity in the diagnosis of kidney lesions may be considered from both the standpoint of diagnosis of the actual condition present, as well as from the standpoint of aid given the surgeon in predetermining the conditions which he may expect to encounter at operation. If pneumoperitoneum is a material aid in either of these conditions, its mission is fulfilled and it is a justifiable procedure. If, on the contrary, the procedure does not give sufficient aid either in making the correct diagnosis or in furnishing information for the surgeon, to justify its inconvenience, then the procedure is not of enough value to warrant its use. Since the method is new and clinical observations are restricted to relatively few cases, definite conclusions cannot be drawn as to the usefulness of the method for a considerable period of time. Until sufficient proof is at hand of the effectiveness of the method in abdominal diagnosis each must judge for himself the relative merits of the procedure in the diagnosis of various conditions as they present themselves.

In reviewing our cases of pneumoperitoneum we have notated the various radiographic characteristics encountered in each condition and have endeavored to correlate the findings for the purpose of differential diagnosis.

In the first place, the method is occasionally useful in determining the actual presence or absence of a kidney. The kidney may have been removed at former operation or may have been completely destroyed by some pathologic process. Even where ureteral catheterization is possible and where no urinary return

is obtained from the affected side, it occasionally happens that there is difficulty in ascertaining the presence or absence of a kidney. It may be impossible to secure a pyelogram on the affected side but this may be due either to the absence of a kidney pelvis where there is no kidney, or to a destruction or enormous dilatation of the kidney pelvis, where a badly infected

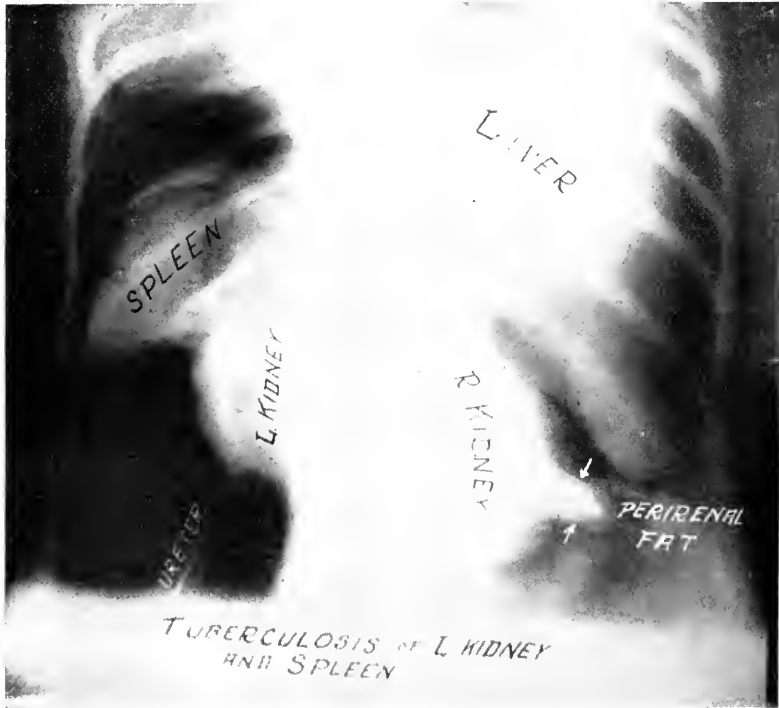


FIG. 1. TUBERCULOSIS LEFT KIDNEY AND SPLEEN, CALCIFICATION OF THE URETER

An irregular deposit of perirenal fat can be seen on the right

or polycystic kidney is present. Under such conditions, therefore, it may be of use in determining the actual presence or absence of a kidney. In this respect the aid derived is more for the guidance of the surgeon in operative interference, than from a diagnostic standpoint (fig. 1).

The position of the kidneys can usually be very easily determined. Normally the kidneys are found lying between the last



dorsal and third lumbar vertebrae. Usually the left is somewhat higher than the right but in a considerable proportion of cases we have found this condition reversed, in apparently normal individuals. The kidneys may be found, however, in almost any portion of the abdomen. Sometimes the mere establishment of the identity of a palpable mass in the abdomen as a displaced kidney may be sufficient to clear up an otherwise obscure diagnosis. Differentiation of an enlarged spleen from a kidney is usually a simple matter.

Abnormal mobility of the kidneys may be found. The range of motion possible in the kidneys of apparently normal individuals varies from the slight displacement which accompanies respiration to the wide range of motion which accompanies change in position. This observation would seem to confirm the present day conception of the abnormality of movable kidneys which determines the extent of pathology present by the degree of ureteral obstruction incident to the change in position of the kidney.

Enlargement of the kidney shadow is one of the most important conditions encountered and requires the most careful analysis for a determination of the cause. Marked variation is encountered in the size of kidneys in various individuals but there is usually very little relative variation in size of the two kidneys in the same individual. Any appreciable variation in the size of the two kidneys should be looked upon as distinctly pathological. Enlargement of the kidney shadow may be due to a heavy deposit of perirenal fat in the kidney capsule or even carcinomatous metastases in the lymph glands and perirenal tissue, and, not primarily to an enlargement of the kidney itself. Excess of perirenal fat, however, rarely gives any pronounced increase in size of the kidney shadow. It is usually accompanied by a broad flat irregular shadow attached to the lower pole of the kidney extending outward. This shadow has been encountered a number of times. It resembles an adhesion but has always been found to be associated with an excess or uneven distribution of the perirenal fat (see fig. 1). Where the enlargement of the kidney shadow is due to secondary malignant involvement

of the surrounding capsule the outline is likewise irregular. It is practically impossible to differentiate this condition from an involvement of the kidney substance. When the enlargement is due to the kidney itself some characteristic feature may be present which will aid in the differentiation of the lesion. The enlargement of the kidney may be uniform and the outline smooth. This is encountered in compensatory hypertrophy of the kidney and in certain types of nephritis. One or other pole of the kidney may show enlargement, the smooth regular outline being preserved. This has been encountered in hypernephroma and congenital anomalies. Where the condition is congenital, it usually effects both kidneys; in hypernephroma, it is unilateral. Observations at intervals may show a progressive enlargement where tumor is the causative agent. There may be uniform enlargement of the kidney with smooth nodular outline. This condition may be due to a polycystic kidney or to a secondary carcinomatous involvement. In polycystic kidney the entire kidney outline is much enlarged while in secondary carcinomatous involvement there is little if any actual enlargement of the kidney. Likewise, in polycystic kidney, the lobulations are large and are rather uniform in size, while in metastatic carcinoma they rarely attain such large size, merely presenting a surface studded with small carcinomatous metastases, more irregular in size and distribution. Irregular enlargement of the kidneys have been encountered in hypernephroma and sarcoma. (fig. 2). These may attain great size and one case of sarcoma of the kidney was encountered in which the growth practically filled the entire abdomen. When the tumor mass is of such great size, it is often difficult to determine whether the kidney is involved at all, since a large mass could easily completely overshadow a normal kidney. Such a condition may require the most dexterous manipulation of the examiner.

In the examination of the kidney outline, the lateral position affords the best view of the kidney. Where an abdominal mass is present, the retroperitoneal position is of great aid in determining its retroperitoneal or abdominal origin and its relationship to the kidney. To obtain this position (fig. 3) the patient,



FIG. 2. SARCOMA OF THE LEFT KIDNEY, SHOWING ENLARGED IRREGULAR OUTLINE

The spleen has been crowded up under the diaphragm

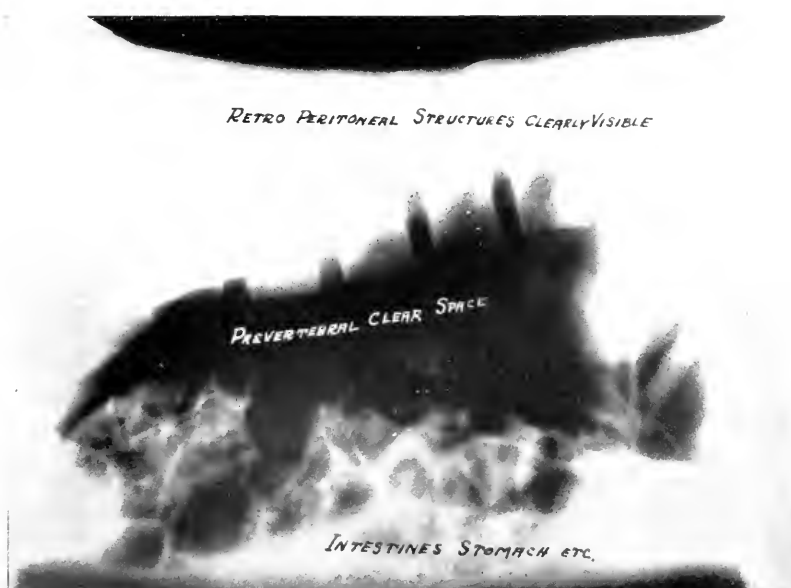


FIG. 3. NORMAL RETROPERITONEAL POSITION

The patient is placed in the prone position, supported by two blocks, allowing the anterior abdominal wall to sag freely forward. The intestines and all organs with mesenteric attachment drop forward leaving the retroperitoneal space clearly visible. A clear prevertebral area is thus formed which is encroached upon when any retroperitoneal mass is present.

previously somewhat over inflated, is placed in the prone position, supported under the chest and thighs, either on a special table designed for that purpose or on two ordinary wooden blocks. This takes all pressure off of the abdomen and permits the intestines, stomach and all organs with mesenteric attachment to fall freely forward giving an unobstructed view of the retroperitoneal structures and creating a prevertebral clear space. Any involvement of the retroperitoneal structures by a new growth or inflammatory mass can be clearly demonstrated. Masses arising in the retroperitoneal space extend into the abdomen encroaching on the prevertebral clear space, while other masses arising from the intra-abdominal organs fall forward leaving the retroperitoneal and prevertebral spaces unobstructed.

The types of retroperitoneal masses most commonly encountered will be briefly considered. The radiographic characteristics in each instance will be mentioned in an attempt to differentiate those affecting the kidney itself from those involving the surrounding structures. New growths of the kidney are round or globular in their appearance (fig. 4) while perinephritic abscesses involve the surrounding structures in a more or less uniform manner (fig. 5). In the lateral view, a tumor mass would cause an enlarged irregular appearance of the kidney outline, while in the acute stage of a perinephritic abscess the kidney outline would show as a clear normal shadow. A psoas abscess may present itself as a very hard mass in the abdomen presenting difficulties to the ordinary methods of diagnosis. In the retroperitoneal position with pneumoperitoneum it can be seen, involving the retroperitoneal structures with a uniform dense shadow (figs. 6 and 7) confined by the psoas muscle and definitely separated from the kidney. Carcinoma of the descending colon may give the same appearance and should be excluded by a barium examination of the colon in the antero-posterior view (fig. 8). In pyelitis there is no change in the kidney outline but in pyelonephritis and other inflammatory lesions of the kidney, the outline is ragged and irregular (fig. 9). In tuberculosis of the kidney the appearance may be essentially the same as that encountered in infections but usually there is some destruction of

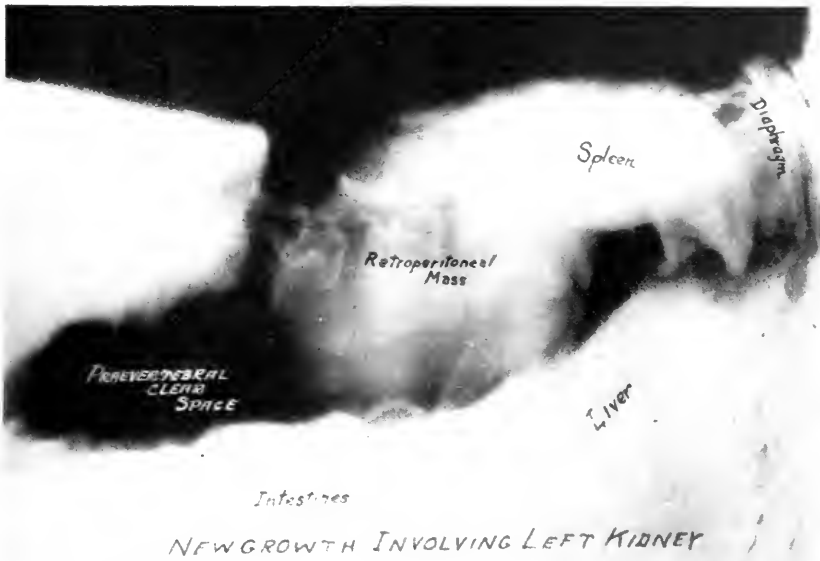


FIG. 4. NEW GROWTH INVOLVING THE KIDNEY

New growths involving the kidney tend to maintain a more or less round or globular appearance. Note the encroachment on the prevertebral clear space.

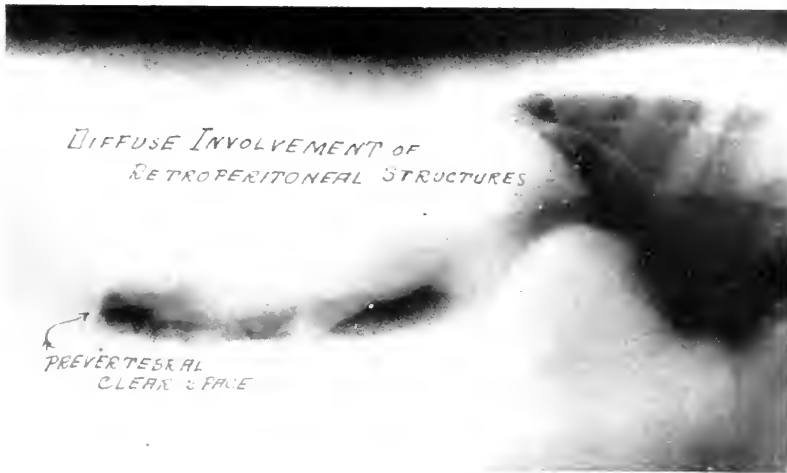


FIG. 5. PERINEPHRITIC ABSCESS SHOWING THE DIFFUSE INVOLVEMENT OF ALL OF THE RETROPERITONEAL SPACE

The prevertebral clear space is almost completely obliterated by the forward bulging of the mass.

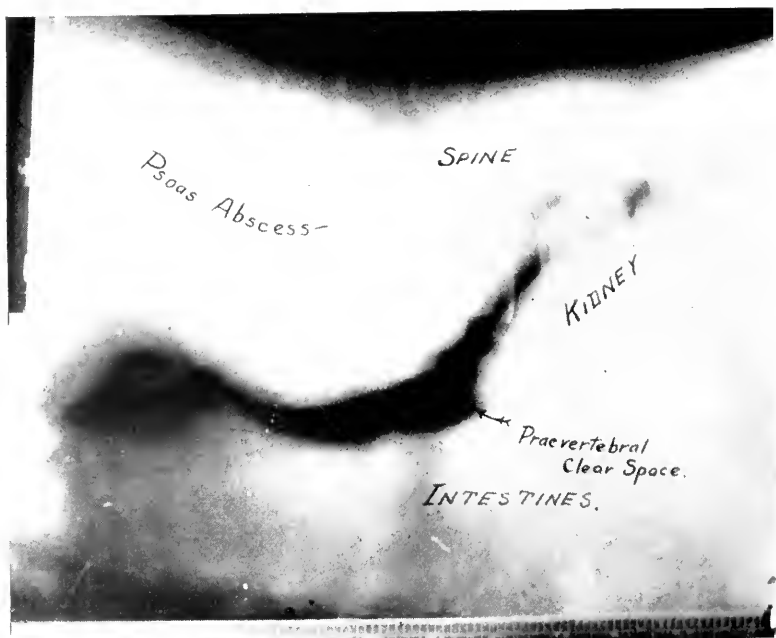


FIG. 6. PSOAS ABSCESS IN THE RETROPERITONEAL VIEW SHOWS A DIFFUSE INVOLVEMENT OF THE RETROPERITONEAL STRUCTURES BUT THE INVOLVED AREA IS LIMITED BY THE PSOAS MUSCLE

The kidney is not involved



FIG. 7. PSOAS ABSCESS SHOWING THE ABSCESS CONFINED BY THE PSOAS MUSCLE AND CAUSING FLARING OF THE KIDNEYS

the kidney and calcareous deposits throughout its substance (see fig. 9). In one instance, during the course of a perinephritic abscess, where an empyema developed, immobilization of the diaphragm and persistent hiccough made the condition suspicious of a subdiaphragmatic involvement. Pneumoperitoneum



FIG. 8. CARCINOMA OF THE DESCENDING COLON AS SEEN IN THE ANTERO-POSTERIOR VIEW

In the retroperitoneal position this might show similar to a psoas abscess or perinephritic abscess.

revealed a clear subdiaphragmatic space and a simple thoracotomy was performed with recovery.

Pneumoperitoneum is likewise of advantage in demonstrating certain lesions peculiar to the urinary tract. Under certain circumstances, when an opaque shadow, suspicious of stone, overlies the kidney area but which is not included in the pelvis

of the kidney as seen in a pyelogram; pneumoperitoneum is of aid in localizing this shadow to the kidney. Where a large round or oval stone is present in the region of the kidney pelvis, this can be clearly demonstrated by pneumoperitoneum. Where such a stone is attendant with infection, or where, by reason of its size and position there might be danger of retention of injected material pneumoperitoneum is to be preferred as a diagnostic procedure to injection of the kidney pelvis. I do not consider the inflation of the abdomen with air for pneumoperitoneum

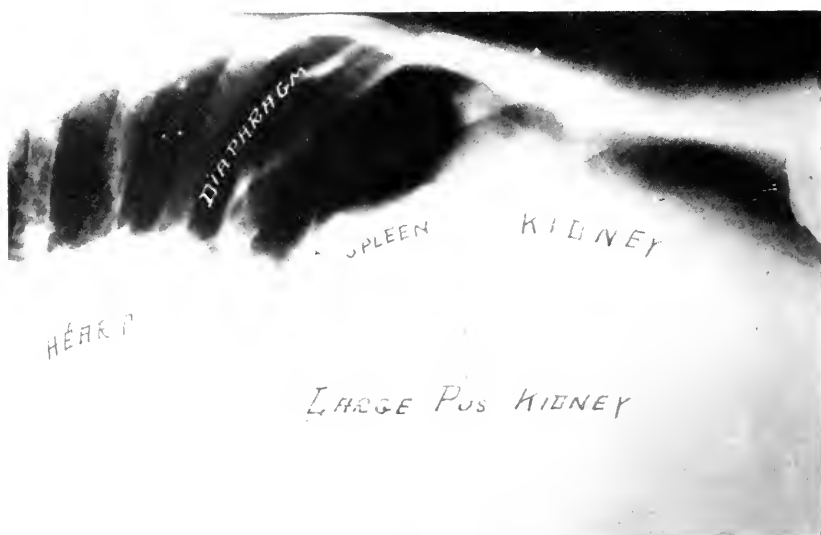


FIG. 9. LARGE Pus KIDNEY SHOWING THE IRREGULARITY OF THE KIDNEY OUTLINE, ITS RAGGED APPEARANCE AND ADHERENCE TO THE LATERAL ABDOMINAL STRUCTURES

In perinephritic abscess in the acute stage, the kidney outline is clear when properly performed, attendant with any more danger than ureteral catheterization and injection of opaque material.

Under fluoroscopic examination by the aid of pneumoperitoneum, opaque material injected into the ureters can be followed up the ureter and into the pelvis of the kidney (fig. 10). This may be of advantage in determining the presence of stricture or kink in the ureter or in determining the relation of the ureter



to some abdominal mass. After the pelvis is filled the catheters may be withdrawn and the emptying process observed. This may be of importance in determining the extent of obstruction caused by any kink or constriction, either organic or mechanical, due to a malposition of the kidney.

In examination of the bladder, the usefulness of pneumoperitoneum is practically limited to observations on the elasticity

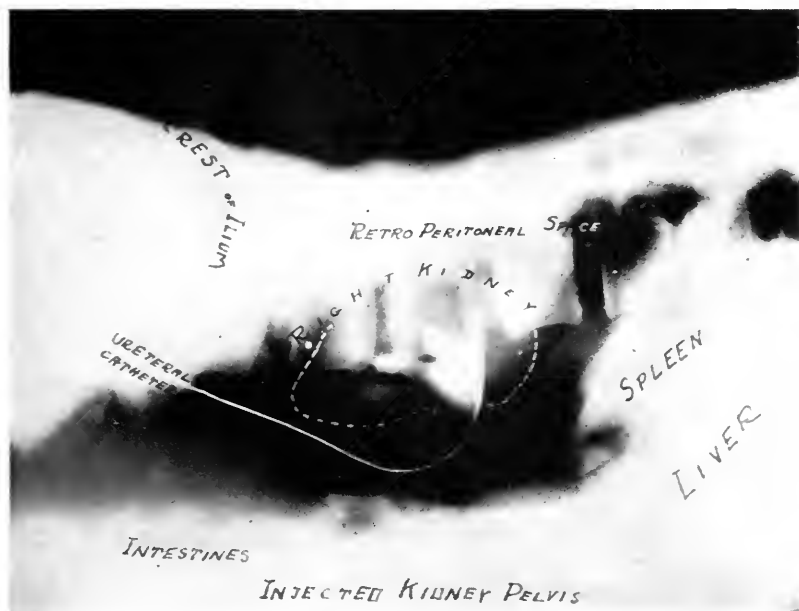


FIG. 10. INJECTED URETER AND KIDNEY PELVIS IN THE RETROPERITONEAL POSITION

When injected in this position the material can be seen under the fluoroscope entering the ureter and filling the pelvis.

of the bladder wall, which can be demonstrated by inflation of the bladder under the fluoroscope and in determining the connection or relation of pelvic masses to the bladder.

Aside from the diagnostic aid offered by pneumoperitoneum some surgeons hold that the mere presence of air in the abdominal cavity is a distinct advantage before operative procedure, since, if an entrance is made into the peritoneal cavity, this will be

detected at once and repair instituted. Where the field is infected this might be of great importance. At any rate the presence of a small amount of air in the abdomen is in no way a hindrance or contra-indication to operative procedure.

In conclusion, it may be well to sound a word of warning. Pneumoperitoneum is not a short cut to diagnosis of all intra-abdominal lesions; its promiscuous use for that purpose will only lead to disappointment and bring discredit on the method. If employed with rational consideration, after all other routine methods have failed to make a diagnosis and interpreted in conjunction with the other clinical findings, I feel confident that the method will give satisfaction and soon become established as a valuable aid in diagnosis.

## THE EXTENSION OF HYPERNEPHROMA BY WAY OF THE RENAL VEIN

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A hypernephromatous kidney with extension of the tumor into the renal vein was removed at the Mayo Clinic and offered an opportunity for a detailed pathologic study of the specimen with the hope of discovering, (1) the point at which the vein was invaded, (2) the manner of invasion, (3) the effect of the growth on the structure of the venous wall, and (4) whether or not the tumor had invaded other routes, such as the arterial or lymphatic.

*Case A351463.* Mr. J. D. B., aged fifty-six years, came to the Mayo Clinic March 4, 1921, complaining of hematuria. Six months before he had had an attack of hematuria without pain and shortly afterward an operation for hemorrhoids. Hematuria recurred in two weeks and again in two months; it lasted only two days and was preceded by severe right side colic requiring morphin. Pain radiating to the genitalia continued until bleeding stopped. During the last two months the patient had had three attacks of bleeding without pain, although clots passed. For two weeks he had had a dull pain in the back especially on the right side and recently pain in the calf of the left leg which was aggravated by standing.

The patient was pale with a moderate degree of alopecia. The radial arteries were slightly thickened; there was general lipomatosis. The right kidney was palpable and about 8 by 12 cm. in diameter. The systolic blood pressure was 102 and the diastolic 80. The erythrocytes numbered 3,450,000, the leukocytes 10,800, and the hemoglobin was 54 per cent. The specific gravity of the urine was 1.011; its reaction was acid; there was a moderate amount of albumen and pus and blood were found on microscopic examination. The renal function was good; 50 per cent of phenolsulphonephthalein returned in two hours, and there was 28 mgm. of blood urea for each 100 cc. of blood. Roentgen-ray examinations of the urinary tract and chest were negative.

Cystoscopic examination revealed blood and pus in the urine from the right ureter. The pyelogram on the right side showed scattered areas of bromid and a dilated kidney pelvis. A diagnosis of right pyonephrosis, probably secondary to renal neoplasm, was made and right nephrectomy advised.



FIG. 1. HILUM OF THE KIDNEY

Mass of tumor tissue pouting from the cut orifice of the renal vein (at *a*)

March 10, 1921, a right nephrectomy through a posterior incision was performed under light ether anesthesia. A growth which appeared to have arisen from the upper pole of the kidney and to have extended along the pelvis and renal vessels was found. The vessels were cut close to their origin. The patient recovered uneventfully and returned to his home on the nineteenth day after the operation. Two months later, he reported by letter that the pain in the left tibial region had

become worse and a localized swelling had occurred at this site without signs of local inflammation. A subsequent letter from his physician contained the information that a spontaneous fracture of the left tibia occurred about June, 1921. The patient died in January, 1922.

*Pathologic study.* The specimen consisted of a right kidney measuring 12 by 8.5 by 5 cm. and weighing 420 gm. The external surface was irregular; numerous yellowish nodules were seen through the translucent capsule which stripped easily from the renal cortex. At the hilum the renal vessels and ureter were in apparently normal anatomic relationship. Filling the lumen of one of the large vessels and extending into its subdivisions was a solid mass of tissue which pouted out at the cut orifice of the vessel (fig. 1). The wall of this vessel was roughened and appeared to be thinned out by the pressure of the occluding mass.

The entire upper pole of the kidney consisted of a mottled yellowish solid tumor traversed by fibrous bands which gave it a somewhat nodular appearance. Extending from the tumor into the pelvis of the kidney was a lappet of tissue which measured 2 by 4 cm. (fig. 2). This lay free in the pelvis not having invaded the wall of the pelvis or the ureter.

Microscopic examination of the tumor revealed the typical morphology of hypernephroma (fig. 3). A stroma consisting for the most part of fine capillaries with a few delicate fibrous strands was thickly beset with large distinctly outlined cells which had a rounded or polygonal contour. The cytoplasm of these cells was vacuolated, an evidence of the lipoid degeneration which is so characteristic of this type of neoplasm. In some places the columnar and cord-like arrangement of the tumor cells was noted, while in a few areas there was considerable round-cell infiltration around the capillaries, suggesting somewhat the sarcoma-like areas in hypernephroma to which Wilson has directed attention.

In the investigation of the paths of extension of the growth a study of the ureter was first undertaken. Numerous sections were studied from blocks cut from the wall of the pelvis and from the adjoining portion of the ureter. These were not invaded. The vascular supply of the kidney was next studied. The renal artery and vein were dissected out to their terminal ramifications, which entered the walls of the renal sinus. Blocks of tissue which included these ramifications for a distance of 1 cm. into the substance of the kidney were excised. A number of sections from the arteries at different points in their course from the kidney outward showed nothing unusual (fig. 4). Cross sections of the renal vein, however, showed some interesting phases of the extension of hypernephroma by this route.

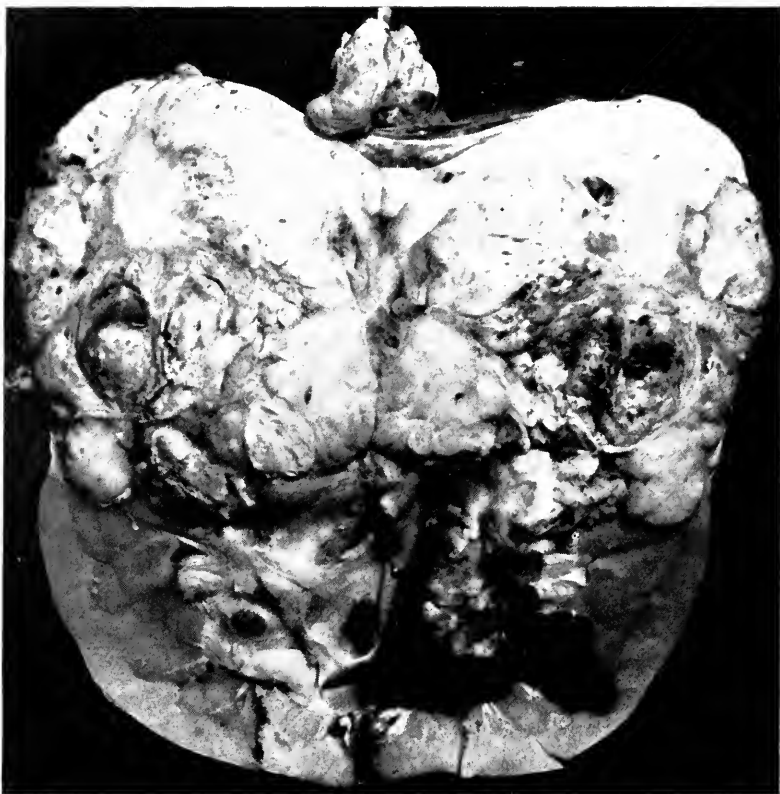


FIG. 2. CUT SURFACE OF THE KIDNEY SHOWING DESTRUCTION OF THE UPPER HALF BY THE TUMOR AND A LAPPET EXTENDING INTO THE PELVIS

A pin marks the ureteral orifice

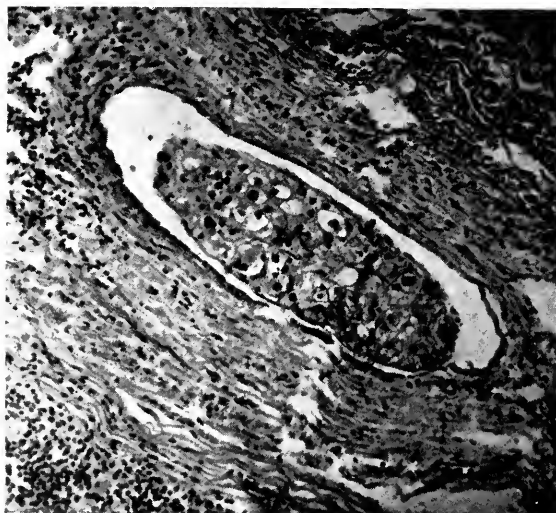


FIG. 3. SECTION FROM TUMOR SHOWING TYPICAL HYPERNEPHROMA MORPHOLOGY ( $\times 100$ )

A section taken from the renal tissue at the point of emergence of one of the smaller radicles of the renal vein (fig. 5) contained a small vessel 0.5 by 0.1 mm. lined by endothelium and with a definite wall of

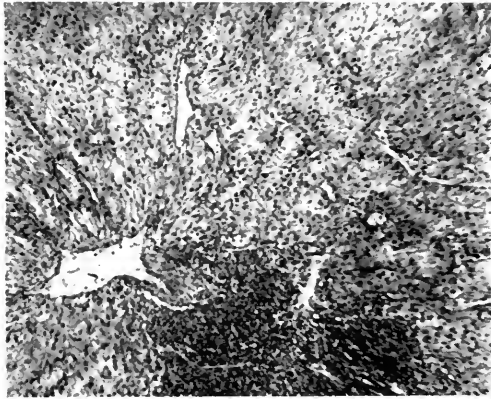


FIG. 4. AREA SHOWING SEVERAL DILATED CAPILLARIES WHOSE LUMINA ARE ENTIRELY FREE FROM THE GROWTH ( $\times 50$ ).

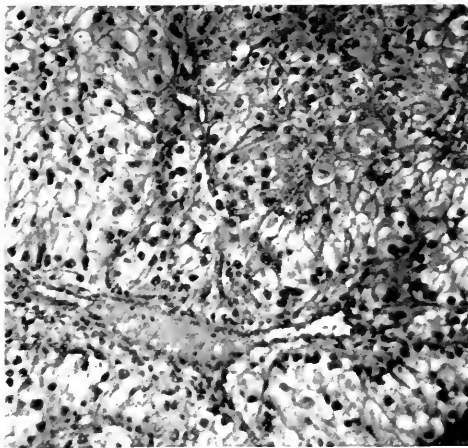


FIG. 5. A SMALL VESSEL NEAR THE HILUM; PROBABLY A TINY VENULE  
Typical hypernephroma tissue lies free in the lumen ( $\times 100$ )

fibrous tissue separating it from the surrounding tumor tissue. No muscle elements could be made out and there was no internal elastic membrane. Hence the structure was either a venule or lymph vessel,

probably the former. The lumen of the vessel was filled with free-lying tissue which consisted of cells and stroma identical in morphology with that of the tumor tissue seen elsewhere. A number of sections through this block showed that the endothelial wall of the vessel remained undisturbed and uninvaded by the tissue growth.

A somewhat larger venous branch is shown in figure 6. The lumen of this was likewise filled with a solid mass of hypernephroma tissue and while the endothelium of the wall had been destroyed there seemed



FIG. 6. A LARGE VEIN JUST BEYOND THE HILUM

Thin walls and lumen filled with tumor tissue are noteworthy features ( $\times 18$ )

to be no active mural invasion by the neoplasm. The vein, however, had been markedly dilated and its walls thinned by the pressure of the growth. A section from the wall of the main renal vein is shown in figure 7. This also showed the lumen to be filled with hypernephroma tissue and the thin wall infiltrated at various points with lymphocytes, although no definite hypernephroma cells were found outside the lumen proper. Numerous sections were made at various points along the venous branches. All showed essentially the same characteristic.



The lumina were filled with the mass but there was little tendency for the growth to invade or perforate the venous wall.

An attempt was made to study the lymphatics of the kidney as a pathway of extension. The renal lymph channels, according to Poirier and Cunco, are superficial and deep. The superficial group is a sub-capsular network which empties, in part, into channels which pour either directly into the deeply situated lymphatics or which run beneath the capsule to the hilum and join the deep lymphatics there. Another group of vessels from the superficial lymphatics perforates the fibrous capsule and runs into the fatty capsule, forming a secondary network

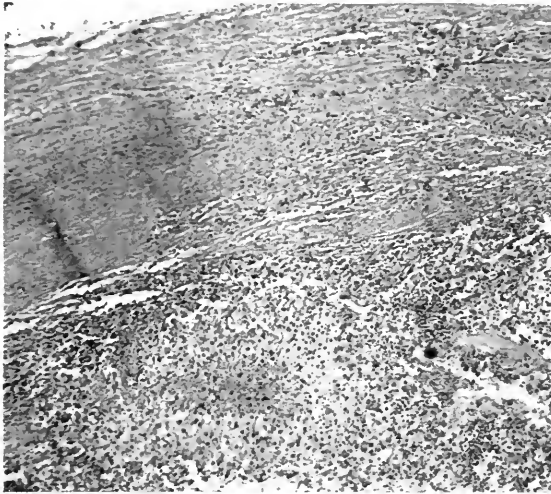


FIG. 7. PORTION OF THE WALL OF THE MAIN RENAL VEIN

Disappearance of lining endothelium, thinning and lymphocytic infiltration of wall, and obliteration of lumen by tumor are seen ( $\times 50$ ).

whose efferents end in the same glands as do the other renal lymphatics. The deep group of renal lymphatics gives rise to several large trunks which dispose themselves around the renal artery and vein and pass through the hilum as satellites of these vessels. The terminal lymph nodes for the kidney are the retrovenous and pre-venous or juxta-aortic nodes, which lie along the aorta at the level of the renal vessels. At the hilum of the kidney are occasional small nodes which interrupt the lymphatic flow but these are always few. The regional nodes are seldom

removed at necropsy and almost never at operation so that we are often handicapped in an effort to study the metastasis of hypernephroma by the lymphatic pathway. Morris cites an instance in which the regional nodes were involved, the secondary growth attaining much greater proportions than the primary tumor in the kidney proper.

In the case under discussion we made numerous paraffin blocks of the fatty capsular tissue, stripped the fibrous capsule with portions of the underlying parenchyma and carefully dissected the tissue around the vessels of the hilum, this being saved and imbedded in paraffin. A careful study of the microscopic sections of this tissue showed no evidence of extension of the tumor by this route. However, such a method was obviously not so satisfactory as a study of the regional nodes would have been.

#### DISCUSSION

The extension of hypernephroma into the renal vein has long been recognized and according to most observers metastasis to the liver, lungs and bones is brought about in this manner. Oberndorfer and Ribbert describe cases in which the growth extended through the renal vein and thence through the vena cava into the heart. MacCallum calls attention to a case in which the primary growth in the left kidney extended by direct contiguity along the left renal vein to the vena cava, thence through the right renal vein to the right kidney, the vena cava itself being blocked by extension of the growth as far up as the entrance of the hepatic veins. Wright reports one case in which tumor tissue was definitely found in the smaller vessels.

All authors are agreed that extension by way of the lymphatics is much less common, although Garceau's table shows that the regional lymph nodes were involved in eleven of 176 patients observed clinically. Many of these patients were not subjected to postmortem examination, otherwise the percentage of involvement of the regional glands would perhaps have been higher. The importance of necropsy studies of this kind is obvious.

Metastasis from hypernephroma may affect any organ and the very multiplicity of tissues involved secondarily suggests that the blood stream is, as a rule, the path of distribution. Metastasis may be found when the renal tumor is so small that

it cannot be palpated clinically and microscopic sections of superficial tumors may be the first to direct attention to the existence of the primary renal growth. Extension by way of the renal arteries is extremely rare if it occurs at all. This will be readily understood if it is considered that under such conditions the growth would have to extend in opposition to the pressure of the arterial current.

Our studies seem to show that, as a rule, hypernephroma enters venules and grows forward into the venous lumina. In its extension it exhibits little tendency to invade or perforate the venous wall which, however, loses its endothelium and becomes thinned out in places from the pressure atrophy, produced by the growing mass. It is easily understood how minute emboli may break off from time to time and be carried by the venous stream to the lungs. Here the cells are arrested or pass on through the capillary bed to the general circulation. Thus metastasis to the bones and other remote tissues occurs. It is suggested by Councilman and MacCallum that the involvement of lymph nodes anatomically unrelated to the kidney primarily involved, may occur secondarily from metastatic growths disseminated by way of the blood stream.

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# THE RELATION OF THE COLON BACILLI OF RENAL INFECTIONS TO STRAINS FROM OTHER SOURCES AND OBSERVATIONS ON THE HEMOLYTIC COLON BACILLI

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The colon bacilli have been believed to be a heterogeneous group by nearly all observers. The correlation of strains from other sources in the same patient with the strain concerned in urinary infection might therefore be of aid in determining the probable source of the urinary infection. Accordingly I have made a comparison by means of serologic and biologic methods of various strains isolated from a series of patients with pyelonephritis.

Eight women with acute pyelonephritis were selected for observation. Two were normal gynecologically; the others represented spontaneous abortion, pregnancy, puerperium, bilateral salpingitis, chronic profuse leukorrhea and convalescence from panhysterectomy. The bacteria of the renal infection in each case were isolated from the urine obtained by catheterization of the kidneys. Pure cultures of hemolytic coli were obtained in five cases and of non-hemolytic in the other three. Smears were then made from the throat, feces and the cervix of the uterus of each patient at the same time as blood agar plates were inoculated. All throat cultures proved negative so far as colon bacilli are concerned. Discrete colonies were transferred for stock cultures in all the cultures of the feces and the cervix which yielded either hemolytic or non-hemolytic colon bacilli.

Monovalent serums were then prepared with each urinary strain by the injection of rabbits intravenously with increasing doses of killed bacteria at five-day intervals. A sufficient titer for the homologous strain developed as a rule one week after

the fourth injection. Agglutination tests were then made with each serum and all the strains of colon bacilli isolated from the patient and the results are summarized in table 1, which shows that the hemolytic fecal strain 2 reacted like the hemolytic urinary strain in case 2 while hemolytic strains 1, 6 and 7 from the cervix of the uterus agglutinated like the respective hemolytic

TABLE 1

ANTICOLON SERUMS PRODUCED BY INJECTION OF RABBITS WITH THE URINARY STRAINS FROM PATIENTS 1 TO 8	TITER OF SERUM WITH HOMOL- OGOUS STRAINS	TITERS OF SERUMS WITH FECAL STRAINS FROM SAME PATIENTS AS URINARY STRAINS				TITERS OF SERUMS WITH STRAINS FROM CERVIX OF UTERUS IN SAME PATIENTS AS URINARY STRAINS				CHANGE OF BLOOD AGAR BY URINARY STRAINS	MACCONKEY FERMENTATION TYPE
		Hemolytic		Non- hemolytic		Hemolytic		Non- hemolytic			
		1	2	1	2	1	2	1	2		
1	800			0	0	800	400	0	0	Hemolytic	B. acidilac- tici
2	3200	3200	3200	0	0					Hemolytic	B.coli com- munis
3	1000			0	0					Non-hem- olytic	B. coli com- munior
4	1600	1600	1600	0	0	1600	1600	0	0	Hemolytic	B. coli com- munior
5	800	0	0	0	0			800	800	Non-hem- olytic	B. aerog- enes
6	1200	0	0	0	0	1200	1200	0	0	Hemolytic	B.coli com- munis
7	800	0	0	0	0	800	800			Hemolytic	B.coli com- munis
8	3200			0	0			0	0	Non-hem- olytic	B. acidilac- tici

urinary strain of each patient. Non-hemolytic strain 5 from the cervix was identical in its reaction with the non-hemolytic urinary strain 5. This patient developed an acute renal infection on the second day after confinement. In patient 4 hemolytic colon bacilli were obtained from both feces and cervix which reacted in agglutination like the urinary strain. No colon bacilli were found in the feces or cervix in patients 3 and 8 which corresponded in agglutination reaction with the urinary strains.

All strains which agglutinated similarly, reacted similarly also on goat blood agar plates.

From the results it would seem that during the course of renal infection with colon bacilli, strains may be isolated from the cervix of the uterus or the feces which correspond in agglutination and growth on blood agar to the strain of the urinary infection and that this occurs oftener perhaps than suspected. This may be due to the high per cent of pelvic involvement in this series. All cultures were taken with great care to avoid contact with anything that might have become contaminated

TABLE 2  
*Cross agglutination of urinary strains*

STRAINS	SERUMS								CHANGE OF BLOOD AGAR
	1	2	3	4	5	6	7	8	
1	800	0	0	0	0	0	0	0	Hemolytic
2	20	3200	0	20	0	1200	800	0	Hemolytic
3	0	0	1000	0	0	0	0	0	Nonhemolytic
4	20	20	0	1600	0	0	0	0	Hemolytic
5	20	20	20	20	800	0	0	0	Nonhemolytic
6	20	3200	0	0	0	1200	800	0	Hemolytic
7	20	3200	0	0	0	1200	800	0	Hemolytic
8	0	0	0	0	0	0	0	3200	Nonhemolytic

by the urine. Dudgeon, Wordley, and Bawtree (1) found colon bacilli in the vagina in thirteen of forty-eight women, in all but two of whom the urine was normal; in one instance of infection, a hemolytic colon bacillus was isolated from both urine and vagina.

Cross agglutination tests were made next of the 8 urinary strains and the results are given in table 2. There was an absence of cross agglutination in 5 strains above a dilution of 1:20 which is within the range of co-agglutinins. In the other three, however, all combinations of serums and strains resulted in similar reactions. These strains, 2, 6, and 7, were all hemolytic and gave the usual sugar fermentation reactions of *B. coli communis*. In order to determine how frequently this specific agglutination occurs among hemolytic colon bacilli, 8 more hemolytic and 4 non-hemolytic stock urinary cultures previously secured

were tested with serums 2 and 6. None gave more than co-agglutination. This serologic grouping of some hemolytic colon bacilli confirms the results of Dudgeon, Wordley and Bawtree (1) who found that a considerable number of hemolytic colon strains in their series could be grouped.

To determine whether there is any relation between the hemolytic property and fermentation, 36 strains of non-hemolytic and 24 strains of hemolytic colon bacilli were classified according to MacConkey's types according to various combinations of positive and negative reactions on saccharose and dulcitate mediums. As may be noted in table 3, there is no relation between fermentation of sugars and the type of blood agar colonies with the possible exception of *B. aerogenes* among which no

TABLE 3  
*Comparison of 60 strains of colon bacilli as to relation of sugar fermentation and change of blood agar*

CHANGE OF BLOOD AGAR	MACCONKEY'S FERMENTATION TYPES			
	<i>B. coli</i> communis	<i>B. coli</i> communior	<i>B. acidi</i> lactici	<i>B. aerogenes</i>
Number of hemolytic.....	11	7	6	0
Number of nonhemolytic.....	14	12	3	7

hemolytic colon strains could be found. Both hemolytic and non-hemolytic occurred in the *B. coli* communis, *B. coli* communior and *B. acidi lactici* types.

Cultures on plain agar of 4 hemolytic strains isolated in 1917 and since tested on blood agar at intervals for four years to determine whether the hemolytic effect persists on artificial cultivation for a prolonged period, showed no decrease in hemolysis on goat blood agar plates at all during this time.

An analysis of 60 histories has been made to learn whether the extent and course of renal infection is influenced by the hemolytic or non-hemolytic type of the colon bacillus in question. A comparative summary of 24 hemolytic and 36 non-hemolytic renal infections is given in table 4 which shows that contrary to Dudgeon and his co-workers, hemolytic colon infections were slightly more common in females than in males.



The average leucocytosis was 13,000 in the hemolytic type of infection as compared with 11,000 in the non-hemolytic. No very definite conclusion can be drawn from a comparison of the duration of infection, as determined from the histories, the persistence, the bladder involvement and the quantitative urinary changes. It would seem, however, from the general summary that as a rule, the hemolytic infections were somewhat more virulent while the non-hemolytic, apparently less severe persisted longer particularly as indicated by the bacteria in the urine. The cultures continued positive during several weeks of

TABLE 4

*Summary of relation of hemolytic and nonhemolytic colon bacilli to various data in 60 cases of renal infection*

CHANGE OF BLOOD AGAR	SEX		AVERAGE DURATION OF INFECTION IN DAYS	TEMPERATURE		BLADDER		PERSISTENCE OF INFECTION		AVERAGE LEUKOCYTOSIS	PUS CONTENT OF URINE			BACTERIAL CONTENT OF URINE			
	Male	Female		Normal to 100°F. 100°F. +	Normal	Moderate inflammation	Marked inflammation	Average number treat- ments to cure	Number cases not fol- lowed to cure		3 +	2 +	1 +	3 +	2 +	1 +	
Hemolytic.....	4	20	14	7	17	5	11	8	4	15	13,000	11	6	7	18	4	2
Nonhemolytic.....	9	27	47	11	25	9	20	7	7	22	11,000	7	9	20	23	8	5

treatment although the pus content frequently decreased to such an extent as to border on the so-called bacteriuria state. Infections of high and low virulence were found in certain instances of both hemolytic and non-hemolytic types of infection.

The production of hemolysis by colon bacilli has been noted by only few and this property has received but little attention in comparison to other characteristics. Schottmuller and Much (2) refer to the presence of hemolytic colon bacilli in fecal cultures without evident gastro-intestinal disturbances. Schmidt (3) mentions the occurrence of hemolytic colon bacilli in both feces and urine and he found a slightly higher percentage in the

feces of patients with diarrhea than under normal conditions. Lyon (4) reported in detail a case of cystitis caused by a hemolytic colon bacillus. The most complete article on hemolytic colon bacilli is that by Dudgeon and his co-workers (1). In addition to the results stated they noted an incidence of 13 per cent hemolytic colon bacilli in normal feces and 24 per cent in the feces in colitis. They also report improvement in colitis following the use of vaccines of hemolytic colon bacilli. The incidence of hemolytic colon bacilli in my series of renal infections was 40 per cent which is distinctly higher than in normal feces or vaginal cultures and slightly higher than in abnormal bowel conditions as reported by others. The presence of types in the feces and uterine cervix similar to the type of colon bacillus concerned in the renal infection of the same patient does not seem to be infrequent. The exact mode of transmission to the kidney is of course difficult to explain but experiments with a carefully identified colon bacillus in animals may give interesting results in determining the route of infection. It is noteworthy that in many instances in my series each type, whether hemolytic or non-hemolytic, persisted as such in the urinary tract for weeks and months without any change or mixture with the other type. Many re-cultures were made at frequent intervals during this time. Dudgeon, Wordley and Bawtree (1), report but a single instance of mixed types in their series of urinary colon infections. If there is continual transmission of colon bacilli from the intestinal tract to the infected kidney, as commonly advocated, it would seem reasonable to expect that mixed types would appear more frequently in urinary cultures, unless of course the particular type that originally infected the kidney continues a selective localization. It is possible that if bacteria are being excreted constantly through the kidney, there may be some intermediate focus in which they exist in pure state.

#### SUMMARY

Colon bacilli can be isolated from the cervix of the uterus and from feces of patients with renal infections which correspond in serologic and biologic tests to the bacilli from the urine of the infected kidney.

Some hemolytic colon bacilli belong serologically in the same group.

The hemolytic property is not accidental but persists during weeks of infection in the urinary tract as well as on artificial media.

There is no definite relation between hemolysis by colon bacilli and their fermentation of sugars.

The incidence of hemolytic colon bacilli in renal infections is greater than generally known and this type of bacillus has a greater average of virulence than the non-hemolytic but the latter appears to persist longer.

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## PYELITIS OF PREGNANCY<sup>1</sup>

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Pyelitis as a complication of pregnancy has not received the attention it deserves from the general practitioner. It has been our good fortune to have had an opportunity to study twenty-five cases of pyelitis complicating pregnancy and it is the result of this study that we wish to report.

Much confusion regarding the symptomology and treatment has arisen from the failure to accurately differentiate a simple pyelitis from a pyonephrosis or surgical kidney and from failure to consider whether the condition is one incident to the pregnancy or whether it is an exacerbation of an old renal infection.

### ETIOLOGY

There has been no end of discussion as to the etiology of this condition. The colon bacillus is the most frequent organism found. In this series ten cases showed *B. coli* on culture, three gave no growth and the remainder were not cultured. Cabot has repeatedly emphasized the difficulty of infecting the normal bladder, and the ease with which a cystitis develops when there is some form of urethral or prostatic obstruction. It seems reasonable to suppose that some form of obstruction to the ureter also plays an important rôle in the development of an infection of the renal pelvis. Pressure of the pregnant uterus upon the ureter has long been considered the all important etiological factor. DeLee claims that the specific gravity of the pregnant uterus is about equal to that of the intestinal mass and does not believe that the compression of the uterus can cause obstruc-

<sup>1</sup> Read before the Ninth Councillor District Medical Meeting, January 26, 1922, Marshfield, Wisconsin.

tion. Luys describes how the fetal head may distort the ureters as they enter the bladder during the late months of pregnancy. At this period it is exceedingly difficult to locate the ureteral orifices. In our experience this has frequently been impossible except with a direct vision cystoscope and then they were found to be displaced backward so that one had to hold the cystoscope almost vertically in order to see them. This readily might cause obstruction to flow of urine from the ureter but this could only hold true in the late months. Seventeen of our series began before the sixth month, five after the sixth month, and three after delivery, so we do not feel that the pressure of the uterus is an important factor. We know that during pregnancy there is great engorgement of the pelvic blood vessels which are closely associated with the ureters, yet it does not seem reasonable to believe that they would exert sufficient pressure to cause obstruction. There remains then some form of narrowing of the lumen of the ureter. Hunner has laid so much emphasis upon the association of ureteral stricture in renal infections, especially in women, that one must consider this seriously. In this series of cases the wax bulb catheter was only used in one instance and a definite stricture was found. There is another form of obstruction that plays a part and that is the edema that must exist as a sequence of the pelvic congestion. The results of ureteral catheterization in these cases and in many others that have been reported clearly indicate that there is some inter-ureteral obstruction that is the most important factor in the production of this condition.

#### SYMPTOMS

The symptoms of pyelitis vary greatly depending upon the extent and the severity of the infection. A few of our cases have shown high fever, chills, pain referred to kidneys, with bladder distress. In others the pain in the side has been the predominating feature. This pain has so strongly simulated appendicitis that operation had been suggested in two cases. In two cases, fever alone was the only sign until a careful microscopic examination of the urine made the diagnosis certain.

Three of our cases had the onset of symptoms after delivery. This is an especially important fact to be remembered, for these symptoms would almost always be considered as an indication of a puerperal sepsis.

#### DIAGNOSIS

The diagnosis rests upon a careful history combined with an urological examination with the most important emphasis being laid upon the microscopic examination of the urine. The most difficult differentiation is between pyelitis and appendicitis. The presence of a few pus cells in the urine does not exclude appendicitis. One must carefully consider the onset of the trouble, especially as to the presence or absence of chills. Chills are common in pyelitis but rather rare in appendicitis. The leucocyte count does not aid much for it may be high in both conditions. There is usually a more marked degree of muscular rigidity in appendicitis. Cystoscopy with catheterization of the ureters will always clear up an uncertain diagnosis. We have seldom had to resort to cystoscopy or pyelography for diagnostic purposes but recommend an X-ray examination of all cases to exclude stone.

#### TREATMENT

The treatment of pyelitis of pregnancy resolves itself into three phases: First, medicinal; second, pelvic lavage; and third, surgical; and we believe that is the proper order of procedure. The average case of pyelitis of pregnancy occurring for the first time will respond promptly by rest in bed, elevation of head, and shoulders, forced fluids, with large doses of urotropin. We have given this in 10-grain doses, four times daily with 10 grains of sodium acid phosphate given between these doses in order to render the urine strongly acid. We have tried various alkaline treatments but have found that we cannot obtain the striking results in this condition that we do in pyelitis in children. In the late months of pregnancy we have found that elevation of the foot of the bed in the attempt to have the fetal head drop back from the pelvic brim, has brought great relief.

In undertaking the medical treatment we must always bear in mind that we are dealing with two lives and we must not continue this so long that we jeopardize the life of the fetus. If decided improvement does not occur in the course of a few days resort to catheterization of the ureters with pelvic lavage. Those cases in our series that have had high fevers and repeated chills have had pelvic lavage at once. The results of this treatment are so striking that one is almost tempted to use this to the exclusion of all other methods. Fourteen of this series required one catheterization, three required two, and eight were not catheterized at all. Large catheters no. 8 or no. 9 were used in all instances, except one where a wax bulb of 4 mm. was employed. The pelvis was irrigated with 1:1000 silver nitrate, or 1 per cent solution of mercurochrome. The fever frequently has dropped from 104° to normal in twenty-four hours and remained normal until delivery, a fact that would indicate that there was some form of ureteral obstruction which was relieved by the passage of the catheter rather than that the infection had been overcome by one pelvic lavage. There is practically an immediate cessation of pain. With careful technique there should be no danger to the mother. One of our cases aborted six hours after catheterization of the ureter but this patient insisted upon leaving the hospital at once and going to her home by train, a distance of twenty miles. Two other cases aborted one month after, so this cannot be attributed to the treatment. The remainder went through to term and all were delivered of living children, with exception of two that had especially protracted labors.

As to surgical procedures we do not believe radical measures are ever indicated in pyelitis of pregnancy. The results of our cases have been so satisfactory that we cannot see any justification for such radical procedures as a nephrotomy or nephrectomy. If however, one is so unfortunate as to meet with a case of pyonephrosis then such a course would be indicated but not until this diagnosis has been confirmed by pyelography. We have not had any case where induction of labor was even considered and we are of the opinion that there is no indication for this procedure.



## CONCLUSIONS

Pyelitis occurs frequently in pregnancy and may easily be mistaken for appendicitis. It is probably due in main part to some form of ureteral obstruction producing an infection with *B. coli* as the most common organism found. It may occur at any time during pregnancy or in puerperium. Medical treatment with proper posture, forced fluids and urotropin gives satisfactory results in mild cases. Catheterization of the ureters with pelvic lavage will produce brilliant and almost immediate results. Surgical intervention is practically never indicated unless there is a pyonephrosis, which in the majority of instances antedates the pregnancy and should not be considered as a pyelitis accompanying pregnancy.



## A NEW SIGN IN THE DIAGNOSIS OF URETERAL STONES

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The determination of the presence or absence of ureteral stone is in many instances a difficult matter. The symptoms may be intense and typical and the X-ray may show a shadow resembling that of a stone and yet there may be no stone present. The shadow may be that of a phlebolith or calcified gland and the colics and symptoms may be coming from the effects of ureteral stricture.

It was thought that the suggestion of L. E. Schmidt, to check up the radiogram with the ureteral radiograph catheter in situ would resolve the question; presenting the shadow in the line of the ureter if it were stone and separated from the ureteral line if it were phlebolith. That method sufficed for differentiation in most cases, the negative evidence (in which the shadow is shown distinctly separated from the ureteral line) having been particularly explicit and valuable. But because a given shadow is in the line of the ureter and apparently in contact with a radiograph catheter, does not necessarily prove it to be a stone. It may still be a phlebolith and incidentally in the line of the ureter.

Kretschmer and others have used two exposures from different angles on the same plate in order to get the separation between shadow and catheter at least in one of such exposures. That this is not always successful is shown in figure 1, which shows two exposures on one plate, the questionable shadow keeping to the ureteral line in both and yet proving later to be merely a phlebolith shadow in the line of the ureter.

In a number of instances the writer has resolved the question satisfactorily by the following method: When he has found a

questionable shadow apparently in contact with the radiograph catheter contained in the ureter and still had reason to question the presence of stone, he has withdrawn the catheter and replaced it with a metal ureteral dilator and has made another



FIG. 1. TWO EXPOSURES IN SUCCESSION ON SAME PLATE AT DIFFERING ANGLE

1, Shadow almost in contact with catheter; 2, shadow behind the catheter. Failing to determine question of stone in left ureter.



FIG. 2. STONE-SHADOW IN CONTACT WITH URETERAL CATHETER



FIG. 3. SAME CASE AS FIGURE 2. STONE-SHADOW IN CONTACT WITH URETERAL FORCEPS

exposure of the same field (figs. 2 and 3). If the shadow is that of stone it still shows in contact with the instrument within the ureter (the dilator) and the diagnosis is finished—a stone is



FIG. 4. MRS. S. SHADOW IN CONTACT WITH URETERAL RADIOGRAPH CATHETER, SIMULATING URETERAL STONE

present. But if it be a phlebolith shadow it is now seen to be distinctly separated from the ureter as indicated by the shadow of the dilator; and the diagnosis is equally clear—no stone, but phlebolith (figs. 4 and 5).

The reason for this sequence is that in the first exposure the soft and flexible catheter adapts itself to the usual pelvic curve of the ureter (which happens to be in the line of the phlebolith shadow); while the more rigid dilator shaft straightens out the ureter, making it take a different, straighter, course that separates it from the phlebolith shadow.

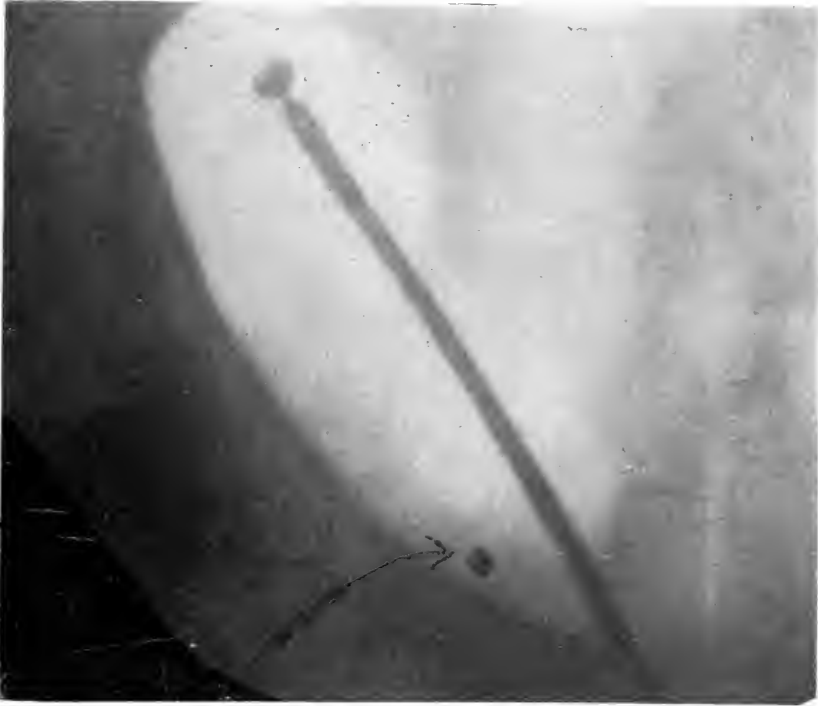


FIG. 5. MRS. S. URETERAL FORCEPS THREE INCHES UP THE URETER AND REMOVING THE URETER FROM THE SHADOW OF A PHLEBOLITH, PREVIOUSLY IN CONTACT WITH A URETERAL CATHETER

The logic of the method and results of its use in some questionable and really difficult cases are depicted in the accompanying illustrations.

Ureteral colics of great severity and typical symptoms of ureteral stone had existed in these cases from two to seven years; and definite diagnosis of ureteral stone had been made in them:

and yet the method herewith submitted refuted this diagnosis and assisted in establishing the correct diagnosis of ureteral stricture, leading to the proper and successful method of treatment. For instance:



FIG. 6. CASE I

1, Cystoscope; 2, catheter passing well up the right ureter; 3, catheter obstructed (by stricture) in left ureter at  $\frac{1}{2}$  inch above the orifice; 4, shadow suggesting stone in left ureter.

*Case 1.* R. A. female, age fifty-five years, had suffered many attacks of ureteral colic on the left side, covering a period of seven years. She had formerly passed some small calculi after such attacks, affirming the probability of stone. Her vocation as the head of a large hospital was seriously prejudiced by the severity and frequency of the attacks.



The early pictures (fig. 6) showed a shadow apparently in the direct line of the left ureter at about  $1\frac{1}{2}$  inch from its lower orifice. The catheter could not at first be made to pass up as far as the shadow; but later manipulations and dilatings paved the way to the catheter ascending above the site of the shadow but showed it apparently in contact with the shadow (fig. 7). This seemed confirmatory and convincing of



FIG. 7. CASE I

1, Catheter passing up left ureter; 2, shadow apparently of stone in ureter and in contact with the catheter.

stone but in view of other misleading experiences it was deemed desirable to check up with other tests.

A double exposure (fig. 1) showed nothing different; and an exposure from below, from an entirely different direction failed also to separate the shadow from the catheter. But a radiogram of the metal dilator (fig. 8) and later of the metal ureteral forceps (fig. 9) made the separa-

tion and negatived stone-shadow, indicating phlebolith. It assisted in establishing the presence of ureteral stricture, the dilatation of which in successive sittings afforded relief and reestablished the health of the patient. The relief from the colics was striking and immediate, follow-

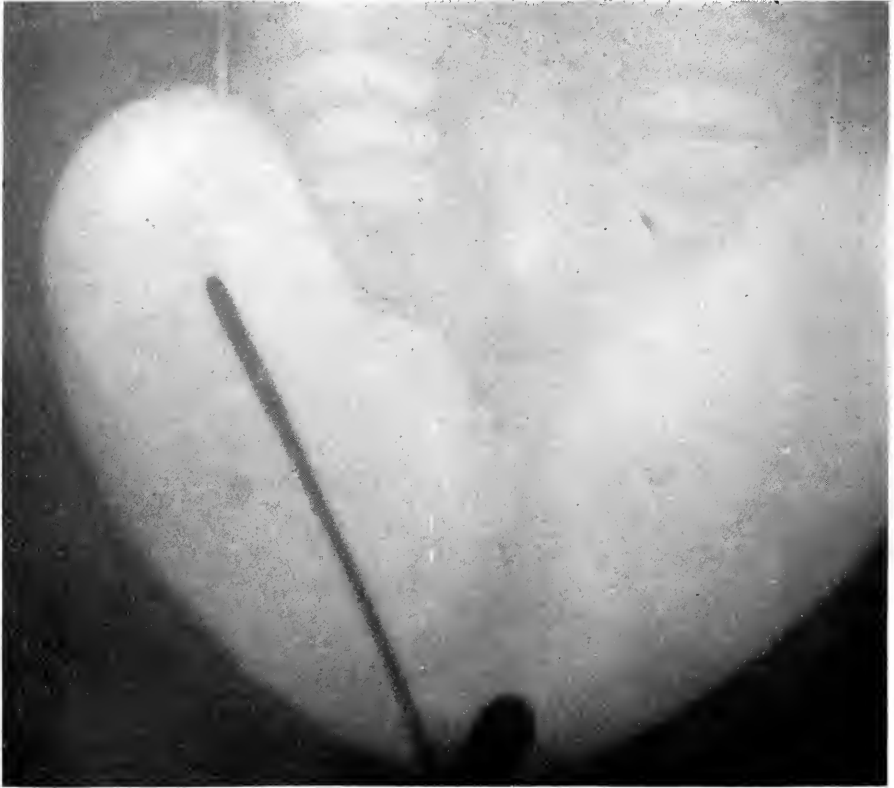


FIG. 8. CASE I

1, Cystoscope; 2, ureteral dilator in left ureter about  $2\frac{1}{2}$  inches; 3, shadow definitely separated.

ing the opening up of the ureteral channel. The relief has continued from October, 1921, to the present time, and without further measures being applied.

*Case 2.* Mrs. Z., age forty-three, complained of renal and ureteral colics covering a period of nineteen years. There had been occasional

hematuria, undue frequency of urination and the urine contained pus. This symptomatology pointed strongly to ureteral stones which suspicion was apparently confirmed by several radiograms which seemed to show shadows in contact with ureteral catheters on both sides



FIG. 9. CASE 1. SHADOW OF FORCEPS AND PHLEBOLITH (DISTINCTLY SEPARATED);  
SHOWING IT TO BE PHLEBOLITH AND NOT STONE

(fig. 10). On the left side the picture taken at different angles made the distinct separation from the catheter shadow that denoted phlebolith. On the right side, however, this separation was not elicited by this means but the demonstration of phlebolith was finally and successfully made by the use of the ureteral forceps, as shown in figure 11.

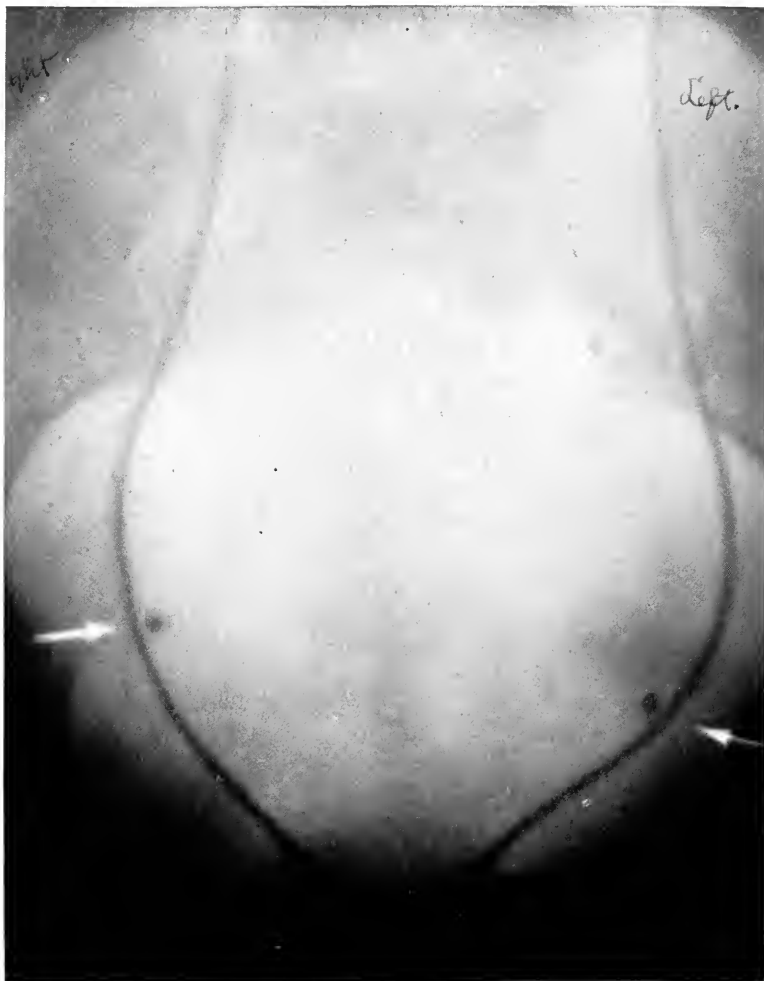


FIG. 10. MRS. Z. HISTORY OF URETERAL COLICS NINETEEN YEARS; OCCASIONAL BLOOD IN URINE

Shadow apparently in contact with ureteral catheter on both sides; suspicion of stones (?).



FIG. 11. RADIOGRAMS OF RIGHT SIDE SHOWING URETERAL FORCEPS IN URETER  
AND DISTINCTLY SEPARATED FROM THE SHADOW, WHICH IS THEREBY  
PROVED TO BE PHLEBOLITH

The shadow on the left side was proved to be phlebolith in the same way.



## HUMAN BLADDER MUSCLE UNDER INCREASED TENSION

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It has recently been stated that the smooth muscle of the bladder of the dog may be transformed into cross-striated muscle by increasing the tension within that organ. Carey<sup>1</sup> for a period of nearly two months pumped boric acid solution into the bladder through a suprapubic tube in daily increasing amounts. As a result of this treatment, the bladder gradually developed rhythmic contraction which could be made to simulate the contractions of cardiac muscle by varying the pressure. Upon the death of the animal from uremic toxemia, autopsy showed an hypertrophied bladder, double hydroureter and hydronephrosis. The smooth muscle of the bladder was transformed into cross-striated muscle.

If it could be shown that a like change took place in the human bladder, when its walls have been subjected to increased hydrostatic pressure for a long period, this observation would have a direct bearing on certain clinical problems. If the human bladder developed the morphological characteristics of voluntary muscle and rhythmic contractility under increased tension, the dribbling of urine which occurs in cases of urethral obstruction might be explained. Such a change in the vesical muscle might also account for many cases of eneuresis in children.

The conditions produced in Carey's experiment are closely approximated as the result of certain pathological conditions of childhood and through the courtesy of the Pathological Department I was able to study the bladders from two such cases. The dilated bladder from a fetus with rudimentary external genitalia was also examined.

<sup>1</sup> Carey, E. T. Studies in the dynamics of histogenesis, etc. *Am. Jour. Anat.*, xxix, 1921, p. 341.

Specimen 1 was from the bladder of a child, who died at the age of two months from the results of a congenital obstruction in the posterior urethra.<sup>2</sup> Pressure in the bladder had been great enough and of sufficient duration to produce hydronephrosis, hydroureter and marked hypertrophy of the bladder (the wall measured 9 mm. in thickness).

Specimen 2 was from a child who died at the age of fifteen months, after having shown clinical evidence of increased tension in the bladder for more than five months.<sup>3</sup> At the autopsy a valve-like obstruction in the posterior urethra was found, with marked hydronephrosis, hydroureter and an hypertrophy of the bladder wall to 15 mm. in thickness.

Specimen 3 was a fetus of about three months. The external genitalia were represented by a minute elevation of the perineum. The bladder was considerably larger than the fetal head. The ureters were not dilated; there was no hydronephrosis.

The muscle fibres of these bladders were all of the non-striated variety and there was no evidence that the increased hydrostatic pressure, under which they had developed, had caused any metaplasia into fibres of the voluntary or cardiac type.

In each of these cases conditions were present favorable to the transition of involuntary muscle into striated muscle, if increase in hydrostatic pressure can produce such a change in the human bladder.

The tissue cells were young—in one case from the third fetal month and if such changes could occur then clearly this embryological and infantile tissue would be most apt to show them. The pressure was prolonged—in the infantile cases it had existed for two and fifteen months, respectively. It was so great that it caused hydronephrosis and hydroureter, with marked hypertrophy of the bladder in the infants and caused enormous dilatation in the fetus. Yet in none of these cases did the bladder muscle show cross-striations.

*Conclusion.* The smooth muscle of the human bladder does not become striated when subjected to prolonged increase in tension.

<sup>2</sup> Reported at length as case 1, Young, H. H., et al. Jour. Urol., iii, 1919, p. 289.

<sup>3</sup> Reported as case IV, *ibid.*



## SCROTAL BANDAGES<sup>1</sup>

CLYDE W. COLLINGS

*From the Department of Urology, Bellevue Hospital, New York*

In the Urological Service of Bellevue Hospital, gonorrheal epididymitis is treated in the following manner:

The patient is confined to his bed, testicles are elevated with an adhesive suspensory and an ice bag is applied to the inflamed part.

The suspensory consists of two pieces of adhesive plaster stuck together at right angles to each other in the form of a "T". The average size of the larger strip of adhesive is 22 inches long by  $4\frac{1}{2}$  inches wide and the smaller one 22 inches long by  $1\frac{1}{2}$  inches wide. This latter piece is divided into three one half inch strips, the two lateral ones being used for perineal straps and the center one to hold a roll of crinolin gauze 1 inch long by  $\frac{1}{2}$  inch diameter, to the suspensory. The purpose of this pad of gauze is to prevent the scrotum from slipping down between the bandage and the perineum. The skin of the scrotum is protected from the adhesive plaster by a piece of gauze.

In applying the suspensory, one hand holds the crinolin pad in the perineum; the scrotum is lifted up so that the weight of the testicle is taken off the spermatic cord; the other hand places the broad strips over the inguinal regions so that they center over the anterior superior spines. The perineal straps are then brought around the legs in the gluteal folds and join the broad strips at the anterior superior spines.

To make the suspensory more durable and stick to the skin better, a piece of adhesive 2 inches wide incorporating the two previous strips is run from the great trochanter of one femur to the other.

<sup>1</sup> Presented before the New York Society American Urological Association, April 27, 1921.

An average of thirty cases of gonorrheal epididymitis a month are admitted to the wards. Usually the patient is free from pain and the temperature is normal forty-eight hours after treatment

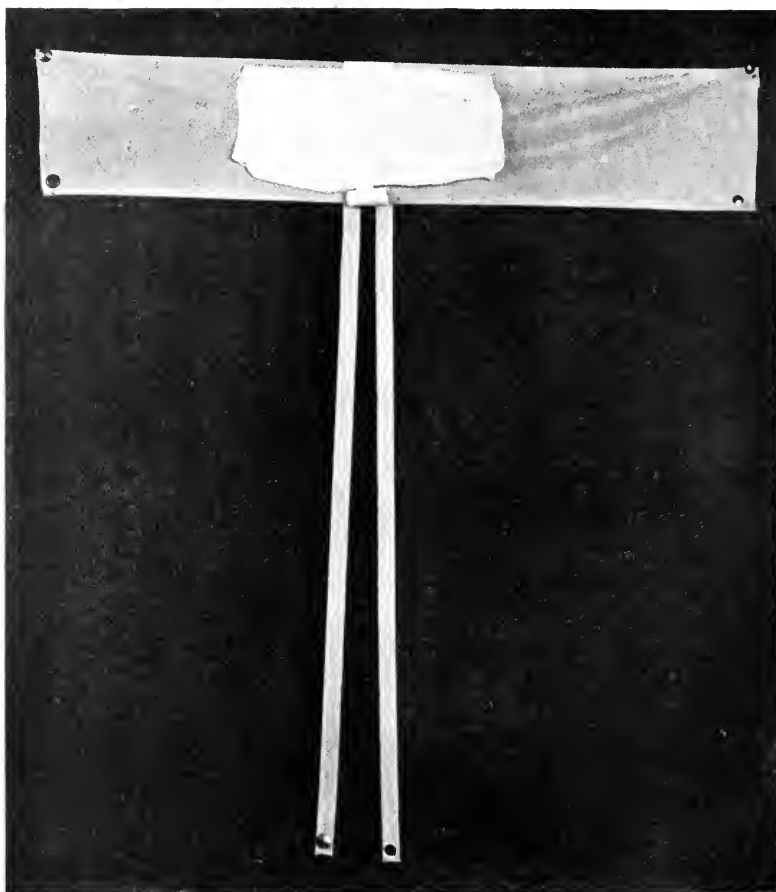


FIG. 1. SUSPENSORY FOR EPIDIDYMITIS

is started. At the end of another forty-eight hours he is allowed out of bed and goes home on the fifth or sixth day.

A re-admission to the hospital after discharge for a recurrence of symptoms is rare, perhaps one case in three months.

If in the first few days the pain does not subside and the temperature is still up, epididymotomy after the method of



FIG. 2. ANTERIOR VIEW OF SUSPENSORY FOR EPIDIDYMITIS

Hagner is performed. This form of treatment is necessary in 7 per cent of the cases.

The non-gonorrheal non-tuberculous type of epididymitis is treated by this method and watched closely to see which way the tide will turn. Sometimes an operation is avoided but in the



FIG. 3. PERINEAL VIEW OF SUSPENSORY FOR EPIDIDYMITIS

majority of cases the epididymis soon suppurates and surgery is resorted to.

An adhesive compression bandage on all scrotal operations has been used on the Urological Service at Bellevue during the past year to prevent post-operative hematoceles.

The compression bandage as suggested by Dr. John Cunningham was used for a time but on account of the adhesive not always



FIG. 4. COMPRESSION BANDAGE FOR SCROTAL OPERATIONS

sticking firmly to the perineum, the bandage was modified by adding perineal straps.

The bandage consists of one piece of adhesive 32 inches long and 6 inches wide. An inverted "V" is cut in the adhesive 16

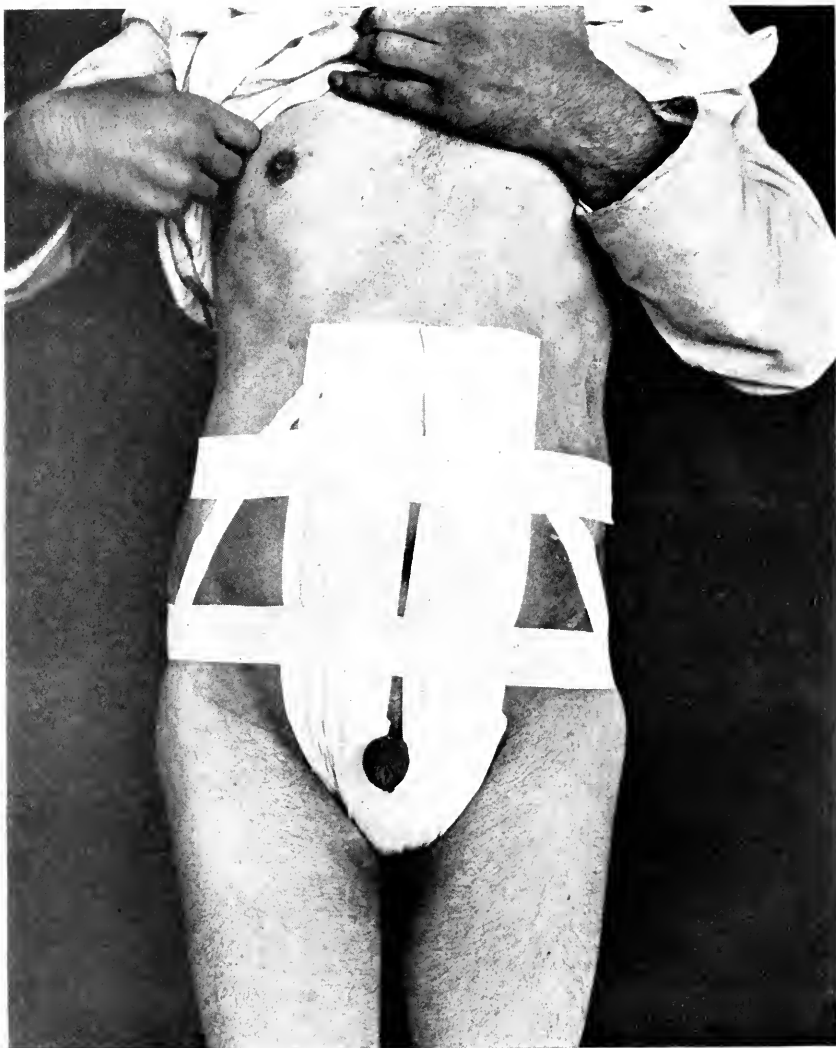


FIG. 5. ANTERIOR VIEW OF COMPRESSION BANDAGE FOR SCROTAL OPERATIONS

inches deep to make the two perineal strips. The top of the bandage is divided into two equal parts and the adhesive torn down 11 inches. The excess adhesive is used to fasten a rolled

up (4 by 8) piece of gauze to the perineal portion of the suspensory. This is applied like the suspensory for acute epididymitis except that the strips applied to the abdominal wall follow the recti muscles on either side of the linea alba.



FIG. 6. PERINEAL VIEW OF COMPRESSION BANDAGE FOR SCROTAL OPERATIONS

An average of 20 scrotal operations are performed a month and only one hematocele has developed during the time the compression bandage has been used.





## INDEX

Abscess, prostatic, A procedure for the cure of.....	397
Adrenals, Malignant disease of the, with report of a case.....	77
Atrophic pyelonephritis.....	247
 Bacilli, colon, The relation of the, of renal infections to strains from other sources and observations on hemolytic colon bacilli.....	473
Baker, J. N. Surgical infections of the kidney.....	307
Baldwin, John C. Human bladder muscle under increased tension.....	499
Bandages, Scrotal.....	501
Barringer, B. S. A procedure for the cure of prostatic abscess.....	397
Bladder, diverticula of the.....	353
—, Foreign bodies in the.....	243
—, muscle, human, under increased tension.....	499
—, Treatment of malignant disease of the prostate and.....	33
—, urinary, Bone metastasis from primary carcinoma of the.....	383
Bone metastasis from primary carcinoma of the urinary bladder.....	383
Braasch, William F. Atrophic pyelonephritis.....	247
Bryan, Robert C., and Caldwell, R. D. Dissolution of calculi in the renal pelvis and ureter.....	295
 Calcification of the seminal vesicles.....	67
Calculi, impacted, Acknowledgment of priority for the treatment of, in the lower end of the ureter released by fulguration.....	161
— in the renal pelvis and ureter, Dissolution of.....	295
Caldwell, R. D., and Bryan, Robert C. Dissolution of calculi in the renal pelvis and ureter.....	295
Campbell, Meredith F. Suction drainage with presentation of an apparatus.....	153
Carcinoma, primary, Bone metastasis from, of the urinary bladder.....	383
Catheters, ureteral, An inexpensive carrier and receptacle for.....	335
Cecil, Arthur B. Urological irrigator sterilizer.....	337
Chute, Arthur L. Some disputed points regarding prostatectomy.....	417
Collings, Clyde W. Scrotal bandages.....	501
Colon bacilli, The relation of the, of renal infections to strains from other sources and observations on hemolytic colon bacilli.....	473
Cook, Ward H., and Cunningham, John H. The operative treatment and pathology of acute epididymitis.....	139
Crosbie, Arthur H. Diverticula of the bladder.....	353
Cunningham, John H., and Cook, Ward H. The operative treatment and pathology of acute epididymitis.....	139
Cystoscopy in men, Saligenin as a local anesthetic for.....	329

Day, R. V. Foreign bodies in the bladder.....	243
Differential functional test with phenolsulphonephthalein, modification of...	73
Diverticula of the bladder.....	353
Drainage, Suction, with presentation of an apparatus.....	153
Drugs, Physiological and pharmacological studies of the prostate gland.	
IV. Response of prostatic muscle to.....	407
Epididymitis, acute, The operative treatment and pathology of.....	139
Epispadias, An operation for the cure of incontinence associated with.....	1
Experimental nephritis, The toxicity of potassium chloride in.....	311
Ferguson, Roy C., and Underhill, Frank P. The toxicity of potassium chloride in experimental nephritis.....	311
Foster, Nellis B. Types of nephritis which lead to uremia.....	235
Foulds, Gordon S., and Keyser, Linwood D. The extension of hypernephroma by way of the renal vein.....	463
Fraser, A. Reith. A survey of the treatment of acute gonorrhea in the male.....	87
Frequency current, high, The use of the, in the treatment of lesions of the deep urethra.....	221
Fulguration, Acknowledgment of priority for the treatment of impacted calculi in the lower end of the ureter released by.....	161
Fuller, H. G. Malignant disease of the adrenals with report of a case.....	77
Functional test, differential, with phenolsulphonephthalein, modification of..	73
Fused kidneys, Unilateral.....	321
Genito-urinary tract, Urethroscopic findings in functional disorders of the...	209
Geraghty, John T. A new method of perineal prostatectomy which insures more perfect functional results. A preliminary report.....	339
Geraghty, J. T. Sphincterotomy per urethram. A simple and safe procedure for the cure of contracture of the vesical orifice.....	367
——. Treatment of malignant disease of the prostate and bladder.....	33
Gonococcal infections of the kidney. Report of a case with traumatic rupture.....	113
Gonorrhea, acute, A survey of the treatment of, in the male.....	87
Hemolytic colon bacilli, The relation of the colon bacilli of renal infections to strains from other sources and observations on.....	473
Herrold, Russell D. The relation of the colon bacilli of renal infections to strains from other sources and observations on hemolytic colon bacilli....	473
Hirschfelder, Arthur D., Welthall, A. G., and Thomas, Gilbert J. Saligenin as a local anesthetic for cystoscopy in men.....	329
Human bladder muscle under increased tension.....	499
Hyman, A. Unilateral fused kidneys.....	321
Hypernephroma, The extension of, by way of the renal vein.....	463
Impacted calculi, Acknowledgment of priority for the treatment of, in the lower end of the ureter released by fulguration.....	161
Incontinence associated with epispadias, An operation for the cure of.....	1
Infection, prostatic, A case of, complicated by osteomyelitis.....	405

Infections, renal, The relation of the colon bacilli of, to strains from other sources and observations on hemolytic colon bacilli.....	473
Keyser, Linwood D., and Foulds, Gordon S. The extension of hypernephroma by way of the renal vein.....	463
Kidney diagnosis, Pneumoperitoneum in, with special reference to the detection of retroperitoneal masses.....	451
—, Gonococcal infections of the, Report of a case with traumatic rupture.	113
—, Surgical infections of the.....	307
Kidneys, Unilateral fused.....	321
Kretschmer, Herman L. Calcification of the seminal vesicles.....	67
Lesions, The use of the high frequency current in the treatment of, of the deep urethra.....	221
—, urethral, Lympho-cystic, an evidence of systemic tuberculosis.....	165
Levy, Charles S. Presentation of test-tube holder for collection of ureteral specimens.....	333
Lewis, Bransford. A new sign in the diagnosis of ureteral stones.....	487
Macht, David I. Concerning the effect of saline purgatives on the absorption and excretion of phenolsulphonphthalein.....	271
—, Physiological and pharmacological studies of the prostate gland. IV. Response of prostatic muscle to drugs.....	407
Male, A survey of the treatment of acute gonorrhea in the.....	87
—urethra, Chronic infections of the, and its adnexa.....	125
Malignant disease of the adrenals with report of a case.....	77
—disease of the prostate and bladder, Treatment of.....	33
Men, cystoscopy in, Saligenin as a local anesthetic for.....	329
Metastasis, bone, from primary carcinoma of the urinary bladder.....	383
Muscle, human bladder, under increased tension.....	499
—, prostatic, Physiological and pharmacological studies of the prostate gland. IV. Response of, to drugs.....	407
Nephritis, experimental, The toxicity of potassium chloride in.....	311
—, Types of, which lead to uremia.....	235
Osteomyelitis, A case of prostatic infection complicated by.....	405
Pathology of the ureter, Observations on the physiology and.....	259
Paul, H. Ernest. Chronic infections of the male urethra and its adnexa....	125
Pedersen, James. A case of prostatic infection complicated by osteomyelitis.	405
Pelouze, P. S. Lympho-cystic urethral lesions. An evidence of systemic tuberculosis.....	165
Perineal prostatectomy, A new method of, which insures more perfect functional results. A preliminary report.....	339
Peterson, Anders. Modification of differential functional test with phenolsulphonphthalein.....	73
Phenolsulphonphthalein, modification of differential functional test with...	73
Phenolsulphonphthalein, absorption and excretion of, Concerning the effect of saline purgatives on the.....	271

Physiology and pathology of the ureter, Observations on the.....	259
Pneumoperitoneum in kidney diagnosis with special reference to the detection of retroperitoneal masses.....	451
Pneumopyelography.....	285
Potassium chloride, The toxicity of, in experimental nephritis.....	311
Pregnancy, Pyelitis of.....	481
Prostate and bladder, Treatment of the malignant disease of the.....	33
— gland, Physiological and pharmacological studies of the, IV. Response of prostatic muscle to drugs.....	407
Prostatectomy, perineal, A new method of, which insures more perfect functional results. A preliminary report.....	339
—, Some disputed points regarding.....	417
Prostatic abscess, A procedure for the cure of.....	397
— infection, A case of, complicated by osteomyelitis.....	405
— muscle, Physiological and pharmacological studies of the prostate gland. IV. Response of, to drugs.....	407
Purgatives, saline, Concerning the effect of, on the absorption and excretion of phenolsulphonphthalein.....	271
Pyelitis of pregnancy.....	481
Pyelonephritis, Atrophic.....	247
Quinby, Wm. C. Observations on the physiology and pathology of the ureter.....	259
Renal infections, The relation of the colon bacilli of, to strains from other sources and observations on hemolytic colon bacilli.....	473
— pelvis and ureter, Dissolution of calculi in the.....	295
— vein, The extension of hypernephroma by way of the.....	463
Retroperitoneal masses, Pneumoperitoneum in kidney diagnosis with special reference to the detection of.....	451
Rupture, traumatic, Gonococcal infections of the kidney. Report of a case with.....	113
Saligenin as a local anesthetic for cystoscopy in men.....	329
Saline purgatives, Concerning the effect of, on the absorption and excretion of phenolsulphonphthalein.....	271
Sante, L. R. Pneumoperitoneum in kidney diagnosis with special reference to the detection of retroperitoneal masses.....	451
Schroeder, Emma C. An inexpensive carrier and receptacle for ureteral catheters.....	335
Serotal bandages.....	501
Seminal vesicles, Calcification of the.....	67
Sexton, W. G. Pyelitis of pregnancy.....	481
Simmons, R. R. Gonococcal infections of the kidney. Report of a case with traumatic rupture.....	113
Sphincterotomy per urethram. A simple and safe procedure for the cure of contracture of the vesical orifice.....	367
Sterilizer, Urological irrigator.....	337
Stones, ureteral, A new sign in the diagnosis of.....	487
Suction drainage with presentation of an apparatus.....	153
Surgical infections of the kidney.....	307

Test-tube holder for collection of ureteral specimens, Presentation of.....	333
Thompson, Samuel A. Pneumopyelography. A preliminary report on its advantages and technique.....	285
Transactions of the New England Branch of the American Urological Association.....	431
Traumatic rupture. Gonococcal infections of the kidney. Report of a case with.....	113
Tuberculosis, systemic, Lympho-cystic urethral lesions. An evidence of....	165
Underhill, Frank P., and Ferguson, Roy C. The toxicity of potassium chloride in experimental nephritis.....	311
Unilateral fused kidneys.....	321
Uremia, Types of nephritis which lead to.....	235
Ureter, Acknowledgment of priority for the treatment of impacted calculi in the lower end of the, released by fulguration.....	161
—, physiology and pathology of the, Observations on the.....	259
—, renal pelvis and, Dissolution of calculi in the.....	295
Ureteral catheters, An inexpensive carrier and receptacle for.....	335
— specimens, Presentation of test-tube holder for collection of.....	333
— stones, A new sign in the diagnosis of.....	487
Urethra, deep, The use of the high frequency current in the treatment of lesions of the.....	221
—, male, Chronic infections of the, and its adnexa.....	125
—, The structural basis for congenital valve formation in the posterior....	371
Urethral lesions, Lympho-cystic, an evidence of systemic tuberculosis.....	165
Urethroscopic findings in functional disorders of the genito-urinary tract.....	209
Urinary bladder, Bone metastasis from primary carcinoma of the.....	383
Urological irrigator sterilizer.....	337
Vein, renal, The extension of hypernephroma by way of the.....	463
Vesical orifice, Sphincterotomy per urethram. A simple and safe procedure for the cure of contracture of the.....	367
Vesicles, seminal, Calcification of the.....	67
Watson, Ernest M. The structural basis for congenital valve formation in the posterior urethra.....	371
Wells, H. Gideon. Bone metastasis from primary carcinoma of the urinary bladder.....	383
Wethall, A. G., Hirschfelder, Arthur D., and Thomas, Gilbert J. Saligenin as a local anesthetic for cystoscopy in men.....	329
Wolbarst, Abr. L. Urethroscopic findings in functional disorders of the genito-urinary tract.....	209
Young, Hugh H. Acknowledgment of priority for the treatment of impacted calculi in the lower end of the ureter released by fulguration.....	161
—, An operation for the cure of incontinence associated with epispadias....	1
Young, H. McClure. The use of the high frequency current in the treatment of lesions of the deep urethra.....	21



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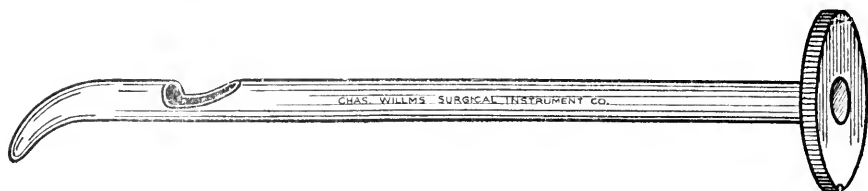
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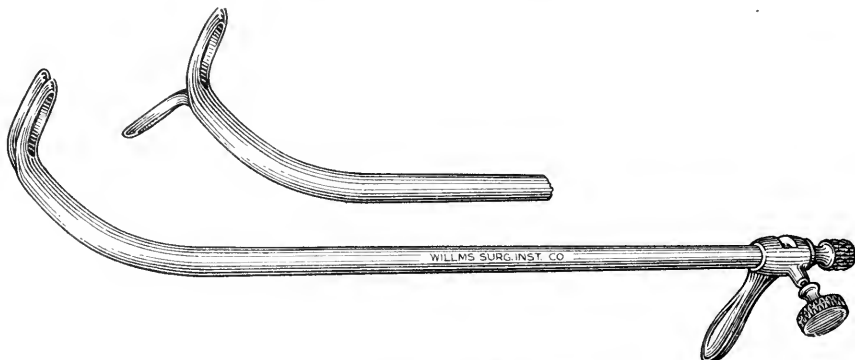
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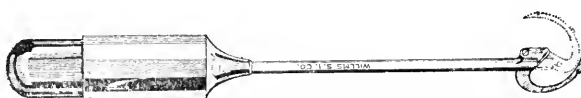
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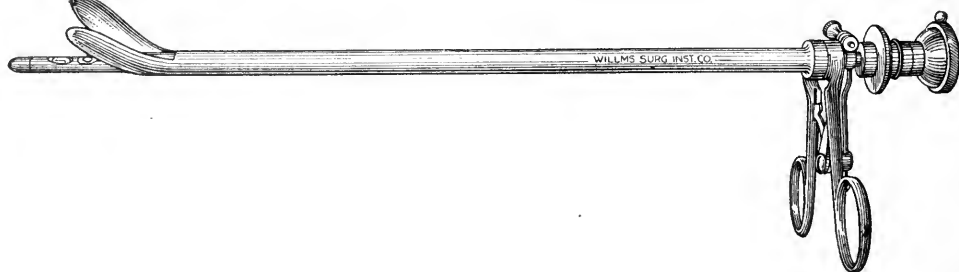
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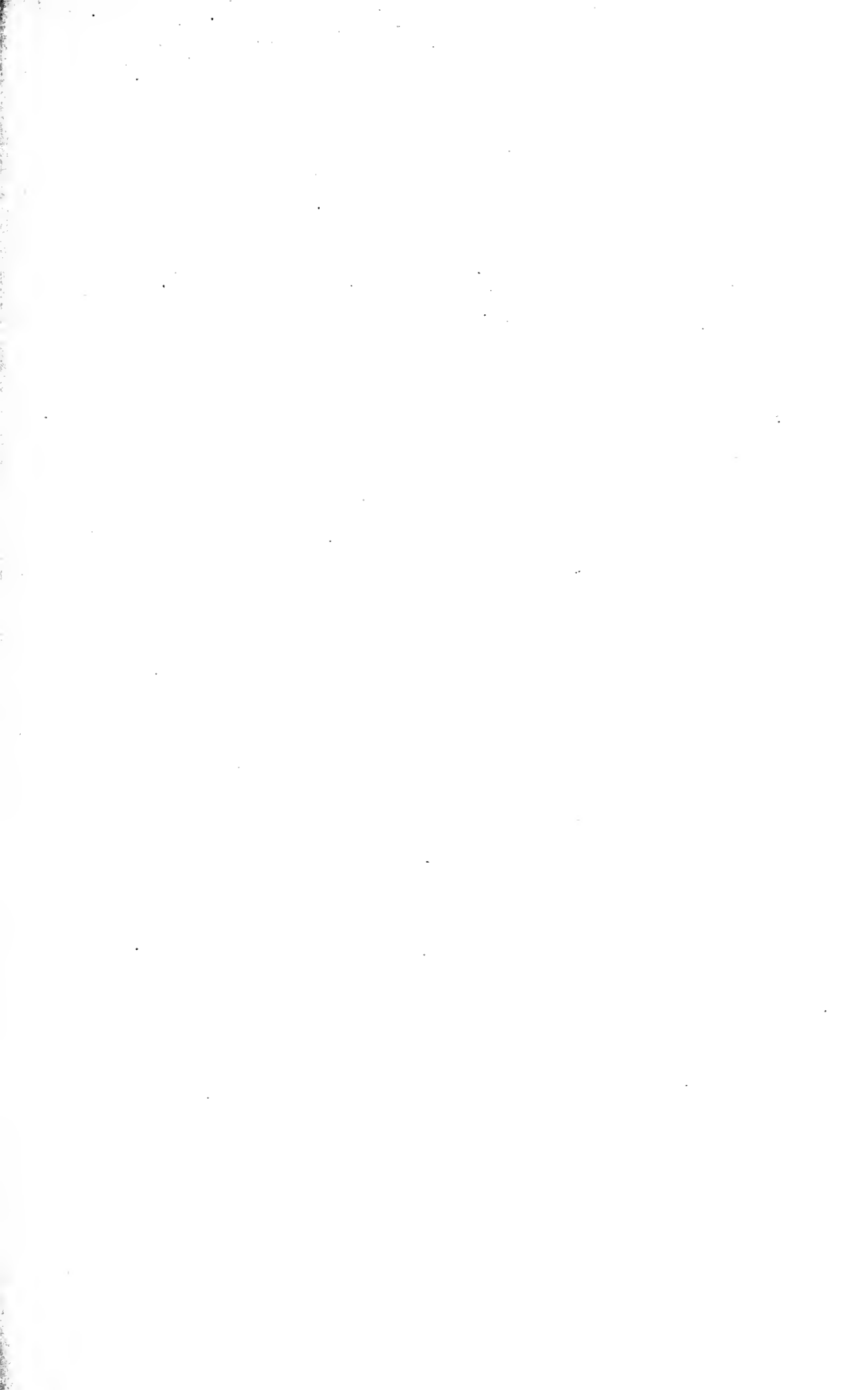
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